POWER PLANT ENGINEERING

CONTENTS FOR THE MONTH OF

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Cover: Opening a valve to a priming pump in a large Chicago pumping station. Photo, Crane Co.

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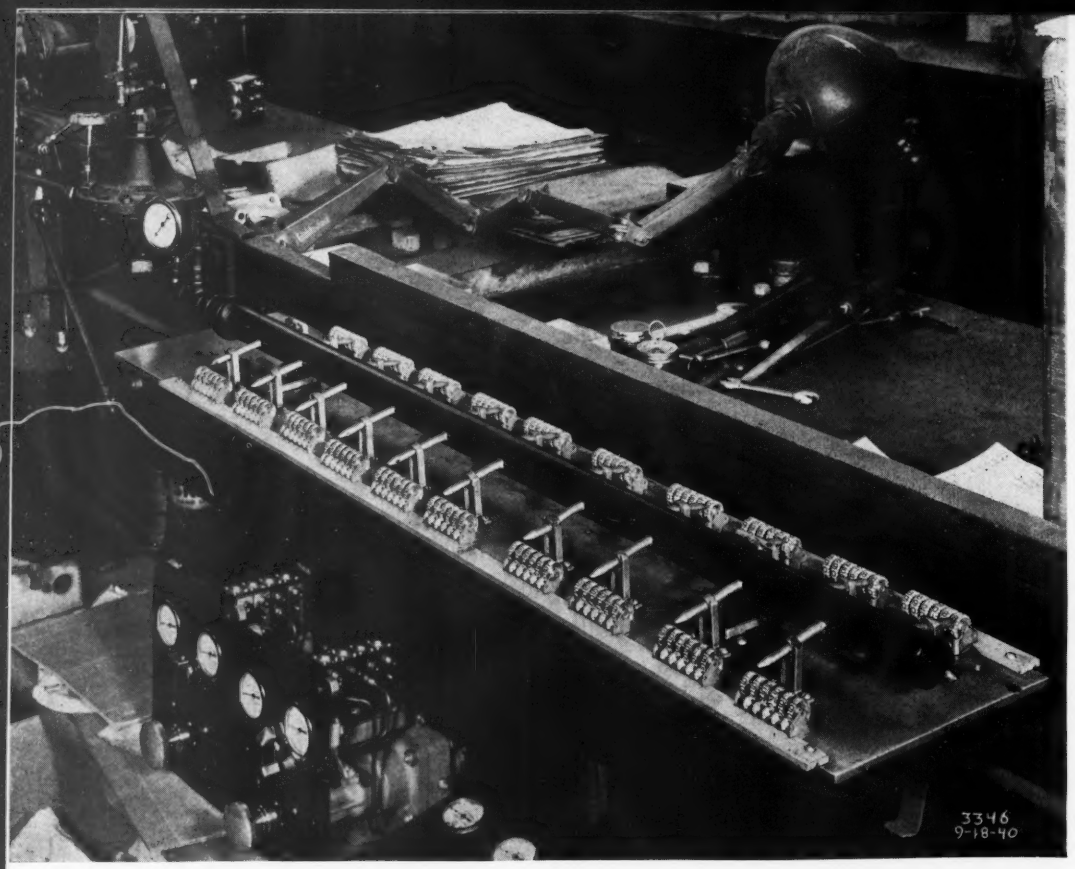

ONCE IN A MILLION

THE ways in which manufacturers solve certain small but often quite important problems is always intriguing. An interesting example of a case of this kind is shown by the photograph above. ¶ At the plant of the Bailey Meter Co. in Cleveland, Ohio, it is of great importance that the integrators, or counters, which form part of all Bailey fluid meters run smoothly and without sticking. These integrators consist of six little wheels carrying numerals from zero to nine on their peripheries, each wheel representing a decimal place in our system of notation, the first representing units and the sixth, hundred thousands. The total count of all six is 999,999, just one short of a million. ¶ It is a simple matter, to fit these six wheels together with an escapement mechanism so that each wheel beyond the first turns one revolution for each ten revolutions of the wheel preceding it. After assembly, however, it is desirable to know whether all six wheels run smoothly without sticking and this introduces the all important question of time. To drive the sixth wheel through even a single revolution, obviously, requires a million revolutions of the first wheel. ¶ The photograph shows the arrangement the Bailey Meter engineers devised to test the integrators. The first wheel of each integrator is placed in front of a small nozzle through which compressed air flows. The air from the nozzle impinging on the teeth at the side of wheel drives the wheel at high speed by turbine action, so fast, in fact, that with a six wheel integrator, the counter is run through its entire travel in approximately two hours time. In other words in 120 minutes the first wheel turns a million times. This is at the rate of 8333 revolutions per minute, while the last wheel turns once in 120 minutes. As may be seen twenty integrators are tested at one time.

With The Editors

◆ **SCOTCH** . . . Frugal and canny are the coal miners, using the coal to generate power before selling it—but nary a B.t.u. is touched. At the High Split Mine in Kentucky coal is sent from the mine to the railroad 4700 ft. away over 25 per cent grade in 25 t. carloads. The loaded car going down pulls up the empty with lots of pep left over. But no mechanical brake takes the rap here, a 500 hp. wound rotor motor does the trick, holding the speed of the cars constant and pumping the excess pep back into a 60 cycle, 4000 v. line. On occasion it can be used as a straight motor to pull up empty cars, men and materials.

At Jewell Ridge, Va., the same idea is used on a 858 ft., 15 per cent grade belt conveyor with a capacity of 500 t. per hr. at 300 ft. per min. speed. Here the induction motor drives the belt when empty or partially loaded and automatically takes over the braking job, when the belt is loaded, by acting as an induction generator.

◆ **PROSPERITY** . . . In the past, economists and pseudo-economists have used everything from bank deposits to wrapping paper as a business index. We have a pet one of our own which we (modestly, not selfishly) kept to ourselves all these years in spite of the fact that it is sensitive and indicates changes in conditions long before they are reflected in the regular business channels.

This indicator is simply the number of unsolicited manuscripts submitted for publication. Apparently there is a lot of truth in the old proverb about going to a busy man if you want a thing done quickly and well. When engineers are busy doing things they have something new to write about. They do it while they are still busy or they put it over until they have more time and forget about it.

Fortunately, enough of them act on the impulse to give a steady flow of articles during any busy periods and it is this willingness to exchange experiences that has advanced engineering and science so rapidly during the past few decades. Contrary to popular opinion engineers as a class write well, not great literature perhaps, but most tell a straightforward story, putting in it such information as they would want in a similar article they were reading.

In spite of involved theories and thick textbooks on technical writing, a good engineering story, like a good news story, reduces to the newspaperman's old formula of "Who, What, When, Where, Why and How"—five W's and an H. If you are a busy engineer who has been procrastinating, try this formula on a few articles.

You will find that explaining to others clarifies things in your own mind, gives you an increased confidence in your knowledge and widens your outlook by bringing you in closer contact with other men in the profession. Every man from fireman to executive who does things even in a routine way has something to tell—something that will be of interest and value to someone else in the field. It's a mistake to feel that the big shots have a corner on all information of value.

◆ **DID YOU KNOW?** . . . William L. Butler, consulting engineer and city smoke inspector of Salt Lake City, has demonstrated that a course in combustion can be made to pay dividends for a city if properly organized. Both elementary and advanced courses are given. The elementary course, which gives the fundamental background, consists of parallel treatment of fuels and chemistry which merge at Lesson 7 into combustion . . . Each lesson has a number of questions for the students to answer and correct answers to the questions are passed out with the subsequent lesson.

◆ **PASS IN REVIEW** . . . This month a large but select army is perfecting plans for an invasion of New York, an army of engineers and executives, quite distinct from the Selective Service group, but impelled by the same undeniable demand, National Defense.

For years we have been hammering away at the short-sightedness of industry in keeping power facilities up to date with an adequate margin of standby. It has been evident for a decade that any material increase in industrial production would throw an undue burden on central stations, a burden which under emergency conditions such as war would have serious consequences.

In spite of the fact that such improvements would have paid a good return even under depression production, industrial power modernization lagged until virtual war conditions hid all but one question: "How can we do it?" Therefore, the trek to New York for the power show and at least a partial answer to the question.

This year the show, officially the 14th Exposition of Power and Mechanical Engineering, takes a new significance, an essential link in the nation's efforts to avoid a power "bottleneck" at all costs. Capacity at any cost is imperative, but capacity alone is only part of the picture.

It is easy to overlook the part old and inefficient power plants play in hampering national defense by throwing an undue burden on the transportation and coal mining industries at a time when their full effectiveness is demanded.

At the show the best and the latest will pass in review to the lively cadence of war drums in Europe, ghoulish music, nourished by the lifeblood of humanity, which can be silenced only by expediting peak production of American industry. And it is power that turns the wheels!

◆ **WINCHELLING** . . . Every once in a while the postman out-does himself. This time it is a note from Chester Earle, for a long time one of our editors, one of the few who bitten by the editoring bug finds a cure before it's too late. He is now out at Republic Flow Meters helping Herb Stoetzel interpret meters to an industrial world. He writes:

"Glad to see the revival of your Round About page. The gossip of the field, when it gives readers names, is always interesting. You could, of course, develop into a veritable Walter Winchell of the B.t.u. Butchers,—something like this:

"Jimmy Hootenanny, chief engineer of the Goofus Mfg. Co., and the management of the company have ph-ph-ph-t-t! Jimmy is now that way about Gadgeteers, Inc."

Nothing to it. All we need is 24 more hours a day, the personality of a centipede, a table in a night club in a different city for each personality, and 10,000 helpers. While the night club is the most appealing, the 10,000 helpers are the most essential.

◆ **STREAMLINED BUT** . . . While one must admire the swanky stream lined gas buggies used for refueling planes, the streamlines cannot hide the fact that this is a clumsy, antiquated method of handling the problem. Wm. N. Beadle, V.P., Byron Jackson Co., Los Angeles, is advocating a solution more in keeping with the times—a network of small fuel lines over the field and served from pumps in a well protected underground fuel storage. Proper pump characteristics would make it possible to fuel any number of planes simultaneously at constant pressure from a large number of convenient locations on the field. Remote controlled valves could be used to isolate any section of the field in case of accident or bombing.

Slag and slagging constitute today's most troublesome boiler problem, an extremely complicated one involving boiler and furnace design, coal characteristics, rate of firing and operating necessities. While it is slowly yielding to research, the operating man must still work out his own salvation, in the light of present day technical knowledge and his own particular operating conditions. In spite of the vast store of accumulated knowledge of coal and ash characteristics as determined in the laboratory, the correlation of these characteristics with operation is largely a question of trial and error. This article is a chronicle of a practical operating man's efforts to relate the two. It deals with a particular phase of the problem, slag or ash disposal in wet and dry bottom industrial plant boiler furnaces. Slagging of boiler tubes and stoppage of gas passages is in this case a minor and incidental factor although it is evident that the two are closely related. It is not the final answer but it is an important milepost marking definite progress.

Coal Characteristics Determine Furnace Performance

By Allan L. Luke, Jr.

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WHILE BOTH intermittent and continuous slag tap furnaces have been in operation for several years in central stations or industrial plants, our first experience was in connection with Unit No. 22. This 375,000 lb. per hr. wet bottom unit designed for intermittent slag tapping went into operation in November 1934. The furnace volume is 14,300 cu. ft. and it originally had a refractory bottom as shown by Figs. 1 and 3.

It was our intention to use Davis[1] Seam coal having a volatile content of approximately 17.00 per cent, sulphur content of 1.50 per cent, and an ash content of 14 per cent. The ash fusion point was close to 2425 deg. F. or well within the manufacturer's specifications which called for a maximum fusion point of 2500 deg. F. To verify this before the slag bottom was decided upon, some of the coal was sent to the Weirton Steel Co. at Weirton, W. Va., for trial in their slag tap furnaces. The coal worked satisfactorily during this test.

When No. 22 was lit off, the load was kept down and successful tapping was experienced with the load as low as 60,000 lb. per hr. of steam. The bottom headers are rectangular and these were covered with brick. It was noticed that this brick covering was melting off and chrome was tried, followed by air cooled re-

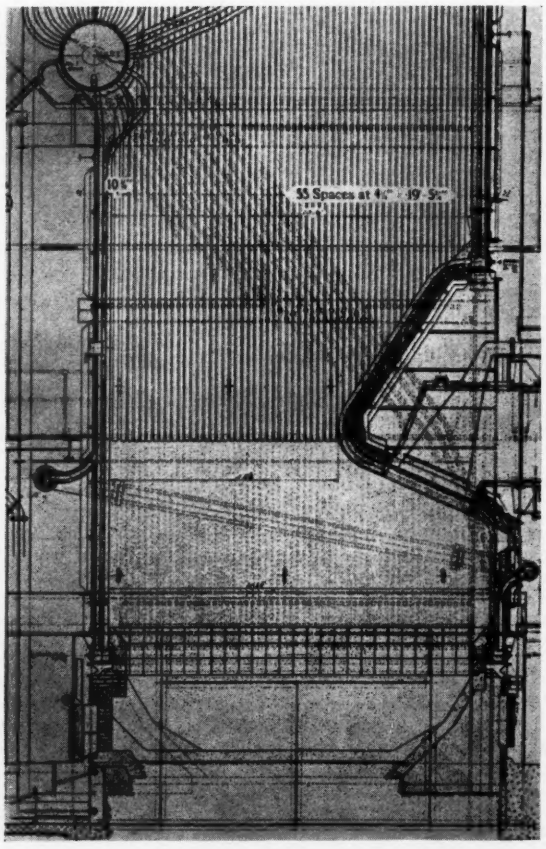


Fig. 1. Furnace cross section of wet bottom boiler Unit No. 22, a wet bottom unit with 14,300 cu. ft. of furnace volume, 16,000 sq. ft. of boiler heating surface, 7,717 sq. ft. of water walls and 43,000 sq. ft. of tubular air heater surface. Steam conditions are 645 lb., 700 deg. F. Details of the furnace bottom and changes are shown by Figs. 3 and 4

[1]Commenting on the designation of coals used in the text the author explains "Coal seams in this section are very mixed, with all the seams having several names. The names in the article are those we use but it would be preferable to designate these seams by the letters used in Pennsylvania by The National Bituminous Coal Commission. These are: The Clarion Seam is known as the A[1] Seam; the Davis Seam is known as the B Seam; the Piedmont Seam is known as the C[1] Seam; the Upper Kittanning is known as the C Seam; the Lower Freeport Seam is known as the D Seam; the Upper Freeport Seam is known as the E Seam; the Bakertown Seam is known by the name of Bakertown. There are two Bakertown Seams, Mastellar and Arthurdale, the former appears in the tables following as simply Bakertown, the latter as Arthurdale. These two mines are about 75 mi. apart, and the coals are in no way similar, in spite of the fact that they are both in the same seam. The volatile content of the Mastellar coal is about 17 per cent, and the Arthurdale coal about 31 per cent. The Arthurdale coal is hard and firm, while the Mastellar coal is quite soft and friable.

fractory. Neither would stand the intense heat. Finally, all the refractory was removed and a stone lining was installed in the furnace. This was highly unsuccessful because the stone was floated out on the slag. After trying to hold a bottom of this type had failed, 2 in. basket tubes were installed as shown by Fig. 4. These tubes seemed to do the job pretty thoroughly and no more trouble along this line was experienced for some time.

In the fall of 1935 a considerable tonnage of storage coal which had been on the yard for some time was used, because the coal had caught fire and we were anxious to get as much benefit from it as possible. This coal had been bought from several different mines, was of poor quality and when this started into the furnace, the slag began to slow up and finally stopped. Every possible effort was made to slag and soda ash was introduced into the furnace from the openings at the burners to act as a flux.

Cooling Tubes Added

We finally had to shut down and tunnelled through the slag to get into the furnace. There we found the slag on the furnace floor to be piled up above the rectangular header. It was about 4 ft. above the bottom of the slag tap door and only about 8 ft. below the burners. The boiler section was found to be slagged badly, clear up in the superheater, and before shutting down the steam temperature had dropped almost to saturation.

It took about 2 wk. to clean the furnace and the boiler and we found a slab of iron about 1 ft. thick covering the entire bottom This iron was in the form of iron sulphide. The unit, when clean, was put back in service, and no more great trouble was experienced until the fall of 1938.

During this period, slagging was erratic and we could not find out why. Sometimes, when our pulverizers were in good shape, slag would not run. Sometimes when we knew the pulverizers were bad, slag ran well. One thing we did notice was that this furnace would slag better when two pulverizers were on than it would with three. The only plausible explanation for this is that three pulverizers furnish more coal than can be properly burned in the furnace and combustion is not as good as with two. Experience proved that this unit would not efficiently exceed 275,000 lb. per hr. of steam.

In the fall of 1938, the slag again stopped altogether and began to build up in the furnace. A shut down and inspection showed that there was a coating of iron sulphide all over the bottom 6 ft. thick in places, especially along the back water wall. Nothing we could do seemed to have much effect on this so we called in a firm which makes a specialty of the removal of impurities from furnaces and they blasted out 210 t. of iron sulphide.

When the boiler was clean, a water cooling system was installed in the bottom and we started up again, a new coal from the Upper Freeport Seam was used. This had a volatile content of approximately 17 per cent, sulphur of 2.50 per cent, ash of 11.00 per cent and an ash fluid point of about 2400 deg. F. The slag was so fluid and ran so freely that it was difficult to keep under control when the slag door was opened.

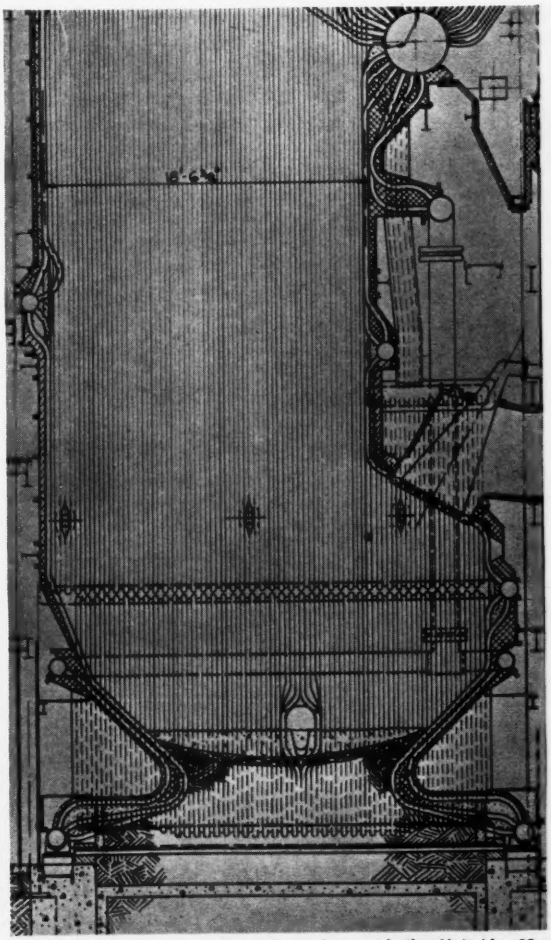


Fig. 2. Furnace cross section of wet bottom boiler Unit No. 23, a 300,000 lb. per hr. unit with a furnace volume of 19,500 cu. ft. and steam conditions of 650 lb., 725 deg. F.

Meanwhile, another intermittent slag tap unit, No. 23, a 300,000 lb. per hr. boiler, shown by Fig. 2, was installed. This is similar to No. 22 except the furnace volume is 19,500 cu. ft. and it has two slag doors instead of one, the idea being that the two doors would facilitate slagging. This unit was put in operation around the middle of May, 1938, and difficulty was experienced at once.

Tapping was very erratic and sometimes several days would expire between successful runs of slag so that it was necessary to shut down at intervals and clean the furnace manually. In the fall, we changed coal in this unit, and went to the Upper Freeport Seam coal.

This worked beautifully, but we could secure only about 30 per cent of our requirements, as the mine production was small. Even with only 30 per cent of this coal, our troubles were greatly lessened and successful tapping was experienced for several months. During this period, the original and main source of coal supply had been steadily increasing in ash content, until in 1938 it was up near 18 per cent ash.

From the first start with the Upper Freeport coal until the coal strike of 1939, there was little trouble with the furnaces as far as slag was concerned. The mines all closed on April 1, 1939, and we had about 15,000 t. of storage coal. This lasted until about April 25 (about 3000 or 4000 t. kept for emergency), when we had to use the coal from a slack bank that had been stored in the atmosphere for several years. This coal had a volatile content of about 25 per cent, ash of about 18 per cent and a

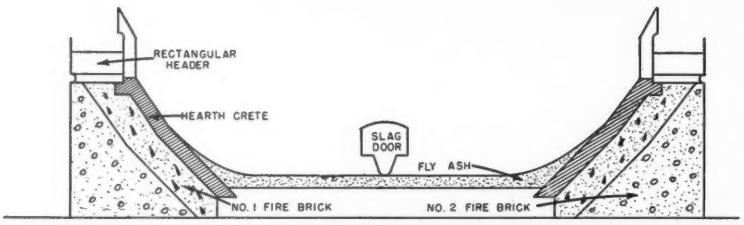


Fig. 3. Detail of furnace bottom in No. 22 as originally constructed and without basket or bottom cooling tubes

fusion point of the ash of above 2700 deg. F.

It worked fine in No. 21, with a dry bottom furnace, but in No. 22 and No. 23 we did not attempt to run slag. Our schedule of operation was: 3 da. operation on No. 22; shut down and put No. 23 on; cool No. 22 rapidly, put in a crew of men to clean the furnace, and have it clean at the end of 3 da., so that No. 23 could come off for cleaning and No. 22 could take up the load. We burned over 10,000 t. of this coal in this manner and it cost us close to $10,000.00 to do it. Fortunately, the ash was soft and porous.

Research Started

Unfortunately, when the strike ended and the miners went back to work, the Upper Freeport mine did not open, and we went back to the old original, the Davis and Bakertown seams. We bought all the low fusion Upper Freeport coal we could get, in railroad cars, trucks and any way we could get it. From June until December we were buying coal from 10 to 15 different mines, and some days there would be that many different coals going into the furnace. Satisfactory results could not be expected, and satisfactory results were not obtained. Slagging was very erratic, and it was necessary to hand clean the furnaces several times.

During this period, it was decided to do a little research work along these lines and see if we could not find the answer to the problem. One thing we knew, that a laboratory fusion furnace would not tell the story. Davis Seam showed a low fusion and fluid point, but would not make good slag. The ash in this coal was up to 18 per cent. We had a good opportunity during this period to try a lot of different coals, ranging from 6 per cent to 18 per cent ash. The lower ash coal slagged better in each instance and the writer made up a chart with the percentage of ash on one side and the fluid temperature of the ash on the other.

A line was drawn through the two extreme points, and it was noticed that in almost every instance, the lower ash coal had the lower fluid temperature and those coals with the low ash had the best slagging qualities. This was knocking at the door, but was not the entire story, as was later learned. The lower ash permitted better combustion between the burner and the surface of the slag, and less blanketing or insulating of the slag by ash. Therefore, higher temperatures could be reached at the surface of the slag.

In October, 1939, we again had to call on outside cleaning specialists. At this time there were several patches of iron sulphide deposit on the bottom of No. 22, all but one of which was removed by us. This one piece, about the size of a dining room table top, was buried. In No. 23, this layer of iron sulphide was from 20 to 24 in. thick, and 66 t. were blasted out. The cooling system in the bottom of each boiler was then raised almost to the lip of the slag tap. Also, about this time, the Upper Freeport or E mine reopened under new management, and we began to receive a few cars of this coal again.

In November, 1939, the writer went to Pittsburgh and had a conference with Percy Nichols, Supervisor of the Fuel Engineering Div. of the U. S. Bureau of Mines, and his assistant, W. T. Reid. These two have done splendid research work on coal ash slags and viscosities and have published several pamphlets on the subject.[2] The slagging properly of coal ash is determined by its chemical composition—something which we had vaguely known, but which we did not know how to translate. On my return, chemical analyses of the ashes of all likely sources of supply of coal in this territory were begun. It took 6 wk. to complete this work but they were completed the first part of January and the results are shown in Tables I and II.

Table I. Data on the ash characteristics of the different coals showing the initial deformation, fusion and fluid temperatures in degrees Fahr. Temperatures were taken with an optical pyrometer and are accurate only within 75-100 deg. F.

COAL SAMPLE	I.D.T.	Temperature in deg. F. FUSION	FLUID	% Ash
Arthurdale	2205	2517	2680	5.80
Davis Seam	2205	2368	2545	13.47
Bakertown Seam	2559	2690	2700+	14.80
Upper Freeport	1911	2245	2445	9.90
Lower Freeport	2559	2760	2700+	15.65
Upper Kittanning	2070	2213	2503	8.85
Clarion	2245	2400	2517	10.10
Piedmont Seam	2320	2517	2654	10.45

While this work was going on, a change in freight rate became effective, and a new source of supply of low fusion coal was opened. This coal has a volatile content of about 25 per cent, sulphur of 2.50 per cent, ash of 8.00 per cent,

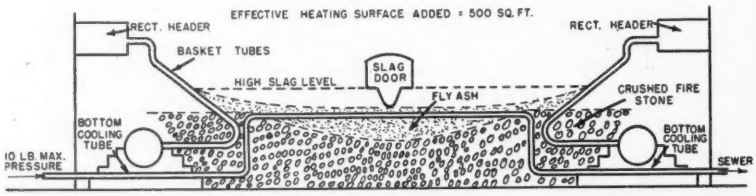


Fig. 4. Changes made in bottom from that shown by Fig. 3. The basket tubes were first added and were later supplemented by the cooling tubes

(1)Sherman, Ralph A., Nicholls, P., and Taylor, Edmund. Study of Some Factors in Removal of Ash as Molten Slag from Powdered-Coal Furnaces: Trans. A. S. M. E., Fuels and Steam Power, Vol. 51, FSP-51-51, 1929, pp. 399-410; (2)Nicholls, P., and Reid, W. T., Fluxing of Ashes and Slags as Related to the Slagging-Type Furnace: Trans. A. S. M. E. Research Papers, Vol. 54, RP-54-9, 1932, pp. 167-190; (3)Nicholls, P., and Reid, W. T., Slags from Slag-Tap Furnaces and Their Properties; Trans. A. S. M. E., Vol. 56, 1934, pp. 447-465; (4)Nicholls, P., and Reid, W. T., Viscosity of Coal-Ash Slags: Trans. A. S. M. E., Vol. 62, pp. 141-153. A more recent paper by P. Nicholls and W. T. Reid, Statues of Knowledge on Properties of Coal Ash was presented at the 26 Fuel Eng. Conf., sponsored by Appalachian Coals, Inc. and held in Washington, D. C., June, 1940.

and a fluid temperature of the ash of about 2450 deg. F. This coal worked very well in both furnaces and was so fluid that care had to be taken in opening the slag door, or the slag would run out too quickly and plug the disposal ditch.

Silica to Flux Significance

It will be observed that there is a figure included in these analyses for the silica to flux ratio. This means the parts of silica for each part of flux, the flux being the sum of the Fe_2O_3, CaO, and MgO. Herein appears to lie the secret. The lower the silica to flux ratio, the better the slagging qualities of that particular ash. In comparing this figure with the various fusion points, it will be seen that the lower the silica to flux ratio, the lower the fluid point of the ash. All it is necessary to do is to determine the silica to flux ratio and you know how your coal will act.

Several pyrometer shots were taken and averaged as the slag left the slag spout lip. These were taken on a satisfactorily fluid slag and the temperature was found to be about 2600 deg. F. From this, a silica to flux ratio of 1.50 would be about our maximum. But here again, another factor enters. What is the viscosity of these slags at various temperatures and will they become sufficienty fluid to flow at the temperature at which we run slag.

If a slag becomes liquid and is too viscous to flow out, we are in trouble. Messrs. Nichols and Reid have determined a means for measuring slag viscosities and have charted several slags from ashes of different coals. These coals cover a rather wide range, and by using this chart, the viscosities of various slags can be determined at a glance. The viscosities of the coals whose ashes we analyzed are shown in the chart by Table III.

These figures were of great value for they tell what coals to use, and what not to use, and what to expect. Even more important is the fact that when mixing coals, we can arrive at some idea of what mixture to use, and in our particular case, mixing coals is almost necessary, as only a few of the local operators are equipped to mine a sufficient amount of coal for our needs, and these few are mining coals with high silica to flux ratios.

This does not provide a method of eliminating the iron sulfide deposits in the furnace bottoms. All the coals with satisfactory silica to flux ratios have fairly high Fe_2O_3 contents and they all have an appreciable SO_3 content. These deposits are formed from particles of coal that have not been thoroughly burned, or from imperfect combustion. Iron sulphide is heavy and when it strikes the slag, it sinks to the bottom at once. The only way we know to eliminate it is through perfect combustion.

Table III. The slag viscosities of the different coals showed a wide variation, expressed in poises at the temperatures indicated

COAL SAMPLE	VISCOSITY (Poises) Temp. in Deg. F. 2800	2600	2400
Arthurdale	100	?	..
Davis Seam	10	25	55
Bakertown Seam	90	?	..
Upper Freeport Seam	1	2	4
Lower Freeport Seam	80	350	..
Upper Kittanning Seam	5	12	25
Clarion Seam	5	12	25
Piedmont Seam	25	70	230

Sometimes this iron sulphide will melt and run out in the form of "sulfur snakes". Our way of combatting this is to insist on clean coal and to give as much turbulence as possible through the burners in order to get the best possible combustion. It is our opinion that if we are able to get satisfactory runs of slag on each shift, so that the slag does not build up in the furnace, the trouble from iron sulphide deposits will be minimized.

Use of fluxes has been suggested several times. As stated early in this paper, we tried fluxes, but without results. Once we even shoveled limestone gravel in through the slag door. The flux melted and ran out and we were right back where we started. Perhaps a flux, such as CaO, could be introduced through the pulverizers, to give as intimate a mixture with the coal as possible and to give even distribution of flux over the slag surface. Probably this can be done but it has one major disadvantage, the danger of slagging up the boiler tubes and superheater with flux.

Table IV. Relative data on the viscosities of different fluids with data expressed in poises

TABLE IV.

Water	0.01 at	68	deg. F.
Light Machine Oil.	0.34 at	100	deg. F.
	1.14 at	60	deg. F.
Olive Oil	0.84 at	68	deg. F.
Heavy Machine Oil.	1.27 at	100	deg. F.
	6.60 at	60	deg. F.
Glycerine	8.30 at	68	deg. F.
	25.18 at	46.5	deg. F.
Castor Oil	9.86 at	68	deg. F.
	24.20 at	50	deg. F.

The poise is the unit of viscosity in the C.G.S. system and is given in terms of Poiseville's Law. A substance is said to have a viscosity of one poise when a force of one dyne is required to move a surface of 1 sq. cm. at a speed of 1 cm. per sec. relative to another plane surface separated from it by a layer 1 cm. thick. A centipoise (0.01 poise) is often used as a more convenient unit and the viscosity of water at 20 deg. C. (68 deg. F.) is taken as one centipoise. The maximum viscosity to run slag is 25 poises. This makes a viscous slag comparable to glycerine at 46.5 deg. F.

Flux Addition

The best way to introduce a flux would be to use a heavy coarse material such as limestone gravel, and put it in close to the slag surface. As even distribution is necessary, this presents quite a problem, but if it becomes necessary for us to use a flux again, we can probably figure out a way to get it in. The use of a flux is a nuisance, is somewhat costly and should be avoided if at all possible.

After the trials and tribulations that we have had with slag tap furnaces, the operation of a dry bottom seems a simple matter. At Piedmont, we frequently feed coal to our dry bottom furnace, No. 21, out of the same bin that feeds No. 22 and No. 23, the wet bottoms. So long as we do not let the CO_2 exceed 14 to 14½ per cent and do not push the boiler far above its specified rating of 80,000 lb. per hr., we experience no difficulty.

It is necessary to lance occasionally, but this is also true of the wet bottoms. The burners of No. 21, however, direct the flame straight out, whereas in No. 22

Table II. Chemical analysis of the ash or slag from the different coals experimented with

COAL	SiO_2	Al_2O_3	TiO_2	Fe_2O_3	CaO	MgO	SO_3	Misc.*	Silica Flux
Arthurdale	48.75	29.32	1.50	15.17	2.96	1.02	.....	1.28	2.55
Davis Seam	39.33	24.86	1.00	23.88	5.18	0.58	4.21	0.96	1.33
Bakertown Seam	51.32	27.85	1.60	15.07	0.83	0.80	.....	2.53	3.07
Upper Freeport	28.59	18.07	0.87	26.79	12.84	0.79	11.01	1.04	0.71
Lower Freeport	47.92	27.17	1.50	14.78	2.20	0.82	1.35	2.26	2.80
Upper Kittanning	35.87	24.77	0.90	28.89	4.07	0.84	3.16	1.50	1.06
Clarion Seam	36.71	24.40	1.10	32.25	1.68	0.84	.....	2.97	1.05
Piedmont Seam	44.69	27.33	1.30	20.36	2.48	0.82	0.61	2.41	1.89

*Consists of Na_2O, K_2O, etc.

and No. 23 the flame is directed down against the surface of the slag. Again, the temperature in No. 21 furnace rarely exceeds 2100 deg. F, whereas Nos. 22 and 23 go up to 3000 deg. F. Under normal operation, we feed No. 21 out of a separate bin that contains high fusing coal, usually Bakertown seam, with a fusing temperature of 2690 deg. F. and we have no trouble whatever. The ash in this furnace is washed out, and though we occasionally find a fairly large clinker, it is seldom so large and hard that it will not break up easily and wash out.

Operating Rules

In closing, there are several rules to be observed in so far as the furnace is concerned in operating slag tap and dry bottom units. They are:

Use the proper coal—low silica to flux ratio ash for slag taps, and high silica to flux ratio ash for dry bottoms.

Close control of CO_2 with not over 15 per cent in slag taps, and 14 per cent in dry bottoms. Going above this causes slagging of the boiler tubes.

Run slag when the load is high, if possible. Do not allow slag to accumulate in furnace. Strive for best possible combustion at all times in both types of furnace.

Keep pulverizers in good shape so that a maximum fineness is obtained. This is very important with wet bottom furnaces.

LONG STEAM LINE SHOWS LOW LOSSES

Two mile, 10 in. steam line carries 50,000 lb. per hr. with 20 lb. pressure and 100 deg. F. temperature loss during low temperature weather

H. K. MILLER
Combustion Engineer,
Steelton Plant
Bethlehem Steel Co.

DATA ACCUMULATED during a month's operation indicates unexpectedly low pressure loss in the steam delivered in a 2 mi. long 10 in. line of all-welded construction which is an adjunct to the new central boiler plant[1] recently installed at Bethlehem Steel Co.'s Steelton Plant, Steelton, Pa.

The Steelton Plant consists of a steel-making division where the central steam plant is located and a two-mile distant division commonly referred to as the "east end works" and consisting of a coke works, a manufacturing division and fabricating shops. The line transmits steam from the central plant to these departments. The steel-making division comprises blast furnaces, open hearth furnaces, rolling mills, a forge department, a steel foundry and various service departments. The east end manufacturing division which makes frogs and switches and railway track accessories will be an important user of the transmitted steam for presses and motive power and aside from supplying the coke plant's needs a considerable amount of steam will be required for heating needs during cold weather, both in the manufacturing division and the fabricating shops.

The transmitted steam takes the place of steam formerly provided by three separate plants located in as many departments. The cost of constructing the long steam line was much less than would have been the cost of a second modern plant to replace these units. The small steam loss in transmission, as operating experience has indicated, is negligible by comparison to the economies that are effected by centralizing steam production for both the steel-making and east end divisions in one unit.

[1]See Bethlehem Steel Installs Central Boiler Plant at Steelton, by H. K. Miller, Power Plant Engineering, p. 35, March, 1940.

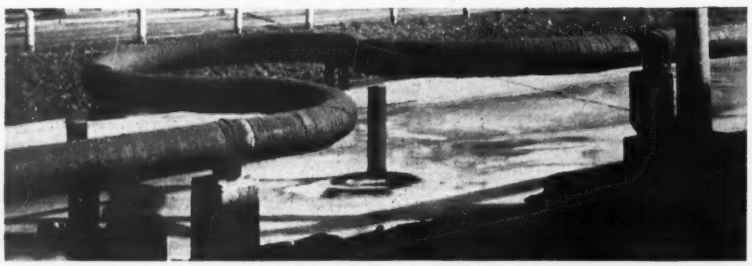


Fig. 1. One of the horizontal loops (Fig. 3C) extending over the plant water supply system, showing the method of support and guiding

Fig. 2. Crossing the river, showing the support from the bridge, a horizontal expansion loop with a difference in elevation, and, in the distance, a vertical expansion loop (Fig. 3C) supported by a single column. Details of the columns are the same as in Fig. 4

One of the three east end plants consisting of four 250 hp. boilers will be retained as an emergency unit. Oil firing has been applied as this fuel can be readily stored and will permit starting this unit very quickly in the event of an emergency.

Selection of the steam pressure and temperature to be maintained in the long steam line was influenced by two limiting conditions. They had to be high enough to provide a sufficient pressure and temperature at the end of the line, and not too high for the existing steam driven equipment in the steel division. A pressure of 250 lbs. was considered ample to give a satisfactory pressure at the end of the line. A temperature of 475 deg. F. was as high as considered safe for the existing steam-using equipment. This temperature would also insure steam of proper

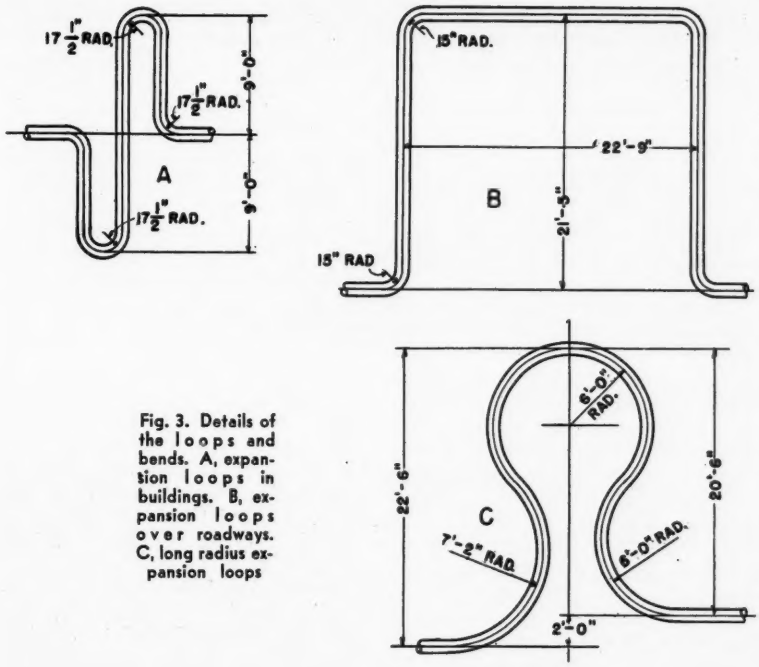


Fig. 3. Details of the loops and bends. A, expansion loops in buildings. B, expansion loops over roadways. C, long radius expansion loops

quality at the distant departments.

A pressure control station was installed at the end of the line to control pressure when the demand for steam was low. In the case of the main turbo generator, a 4500 kw. unit, a separate pressure reducing and desuperheating station was installed to take advantage of the highest permissible pressure and temperature, namely 175 lb. and 450 deg. F.

The new central steam plant which serves the line as well as supplying steam for the steelmaking division contains three boilers with maximum continuous capacities of 125,000 lb. steam per hour each, designed to operate at 250 lbs. per square inch, and 475 deg. F. total temperature. Problems incidental to construction of the pipe line, all connections of which are welded, required careful planning as the line traverses filled marshes adjacent to the plant water supply, crosses a trucking highway, and interdepartment railroad tracks. The line consists of 10,660 ft. of 10¾ in. O.D., 0.365 in. wall thickness lap welded steel pipe supplied in 20 and 40 ft. lengths.

Some of the expansion loops are horizontal and others vertical as clearances dictated. Of the two designs the vertical loops proved less expensive to construct and are in general more satisfactory. Expansion loops having 6 ft. radius bends were pre-fabricated of Bethlehem bending quality lap welded pipe and position-welded in the line. They were spaced at about 500 ft. centers. Loops were prestressed from 6 to 10 in. to take care of the lineal expansion. Preformed sections were used in the short radius 90 deg. bends. Long radius 90 deg. bends were made of bent pipe. The finished line contained approximately 400 10 in. line welds of which 60 per cent were gas welds and 40 per cent electric welds. This line did not develop any leaks or failures under full steam pressure.

The line has 16 long radius expansion loops, Fig. 3C. There are directional changes at six points in the bypassing of tracks and highways which also serve as expansion loops and are comprised of 90 deg. bends, Fig. 3B. Likewise there are three expansion loops in buildings, Fig. 3A, and also an additional half loop of this type. Directional changes in the line involve fourteen 90 deg. bands and four 45 deg. bands in addition to those included in the loops listed above.

At points where the steam line is close to the ground it is supported on cast iron rollers with base and mounted on concrete piers spaced about 25 ft. centers. A bearing saddle 3 in. high was welded to the pipe to protect the insulation and form a bearing surface for the roller supports. At points where the steam main was close to the plant water supply system it was necessary to drive piling to support the concrete piers. Structural steel towers were used for supporting elevated sections passing over highways and railroad tracks, the pipe being suspended by hangers attached to the towers. Vertical loops were suspended from a support placed in the center of the loop. The

TABLE I. DATA ON CONSTRUCTION AND PERFORMANCE OF STEAM LINE

Size of pipe	10 in.
Total length	10,660 ft.
Steam flow per hour	50,400 lb.
Initial steam pressure	240 lb. ga.
Terminal steam pressure	220 lb. ga.
Pressure loss	20 lb. ga.
Initial steam temperature	495 deg. F.
Terminal steam temperature	395 deg. F.
Temperature loss	100 deg. F.
B.t.u. line loss	6.6 per cent

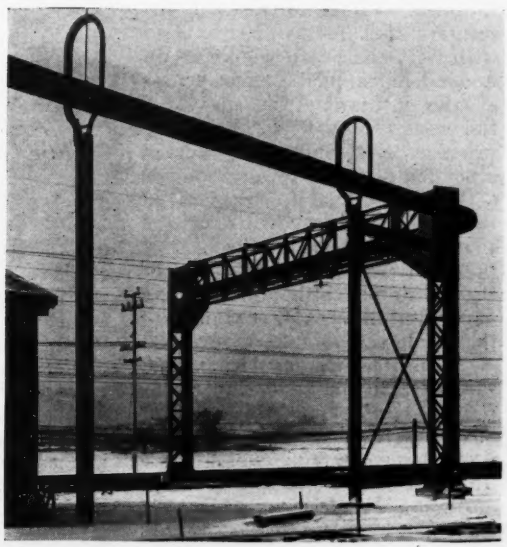


Fig. 4. Bridge over railroad tracks. The single column supports in the foreground are typical, two are used for loops over roadways (Fig. 3B), one for the vertical expansion loops (Fig. 3C and Fig. 2)

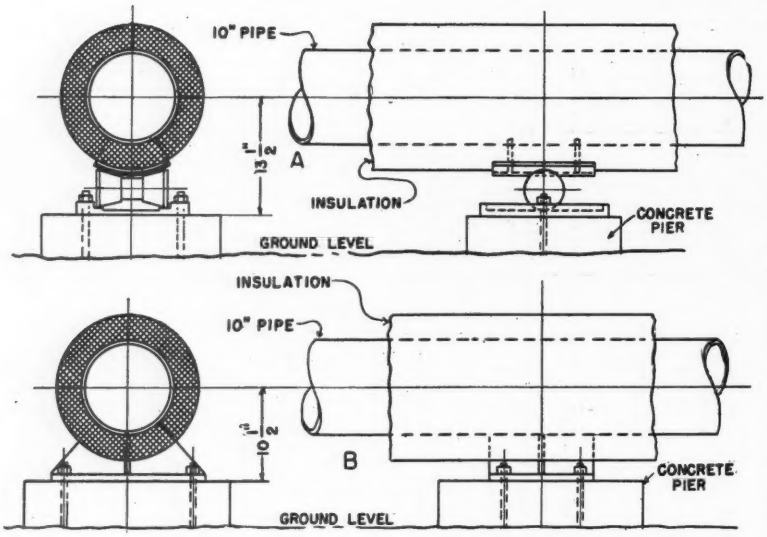


Fig. 5. Further construction details. A, supports between pipe anchorages and B, the pipe anchorages

line was anchored at intervals of approximately 500 ft. to control expansion.

Sponge felt and 85 per cent magnesia in sectional form with water proofing are employed for insulation. For 6400 ft. commencing at the boiler plant the line is insulated with sponge felt, and the 85 per cent magnesia insulation is employed on the remainder of the line. Both types of insulation were applied 3 in. thick in two 1½-in. layers. In order to insure maximum strength and durability the joints in the separate layers were staggered or broken.

All turns and loops were insulated with sponge felt mitered to form. Longitudinal and circumferential seams were filled with Bethlehem slag wool cement. A good index to the effectiveness of the insulation was provided following a heavy snow storm when a drift completely covered a portion of the line. A few days after the storm it was noticed that very little thawing of the snow had occurred in the part of the drift closest to the outside of the insulation although the line had been in regular use during the whole time.

To protect the insulation from the weather the outer layer was provided with one thickness of heavy tarred roofing paper with 4 in. lapped joints, which were carefully cemented in place. Strips of roofing paper 6 in. wide were cemented over the circumferential joints and secured in place by corrosion resisting strap bands. Additional bands spaced about 8 in. centers were used between joints. The completed line was painted with a heavy coating of asphalt paint.

Following is a tabulation of operating data based on performance of the line during the month of March as given in Table I:

Since prevailing temperatures were low during the period for which these records were compiled it is considered that a much higher average efficiency for operation throughout the year may be anticipated. It will be noted that the pressure drop is much lower than might be expected as indicated by the data heretofore available on the operation of steam lines of this type. Factors that may have contributed to this unexpectedly good showing, it is believed, may be the welded construction of the line, as existing formulas are based on operating data obtained from lines of flanged or threaded construction. The abnormally long radius bends, it is believed, may also have contributed to the low temperature losses as they naturally would tend to reduce frictional resistance. The temperature loss was just about what had been expected.

DIESELS FOR NEWTON FALLS

Ohio Municipality installs Diesel plant and distribution system at a cost of $205,000

FOLLOWING a long period of litigation with the local utility company, the municipality of Newton Falls, O., started construction of a Diesel station and electric distribution system in 1939. The total cost of the project ran around $205,000 of which about $80,000 was for the distribution system and some $57,000 for the engine generator sets and auxiliaries. Carl J. Simon of Van Wert, O., was the consulting engineer.

The station has been in operation since the middle of last winter under the direction of E. F. Kestler, superintendent of the Municipal Light, Power and Heat Department. While conditions have been difficult due to the fact that the city is served by two competing systems with a legal requirement of two weeks lapse between discontinuing one service and starting another, the load growth in the city system has been substantial.

In addition to the water works, street lighting, etc., power was supplied to 431 customers in April and approximately 100,000 kw-hr. was generated at an average of about 12.5 kw-hr. per gal. of fuel oil. By September both the number of customers and the number of kilowatt-hours generated had substantially increased and with the coming of winter a further increase is expected.

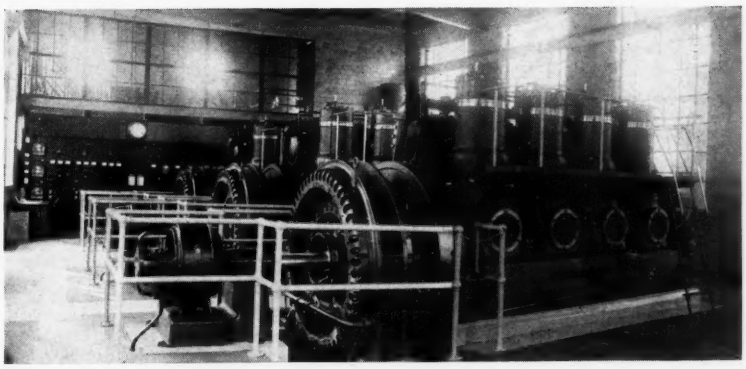


Fig. 1. Interior view of the plant. The engineer's office is on the gallery over the switchboard and there is space in the foreground for two more units. Auxiliaries are grouped in the far corner at the right of the switchboard as shown by Fig. 3

As built, the station consists of three 300 hp. Fairbanks Morse Diesel units with space in the building for two more. They are of the two cycle, 4 cyl. type running at 300 r.p.m. and direct connected to 250 kv-a., 2400 v., 3 ph., 60 cycle generators and 6½ kw., 125 v. exciters. The 10 panel switchboard supplied by the Laganke Elec. Co. has three Allis-Chalmers voltage regulators, circuit breakers and current transformers, Hickok indicating instruments and Esterline-Angus recording meters. Auxiliary power is supplied through a 2400/220 v., 37½ kv-a. Standard transformer and a G.E. voltage regulator is used on the street lighting circuits.

Each engine has a Burgess Snubber in the exhaust and a nest of three American air filters on the air intake. 300 gal. day fuel tanks, located outside and underground near the snubbers are serviced by a F-M oil transfer pump. This pump is installed outdoors and is driven by a ½ hp. fully enclosed motor. Two 10,000 gal. fuel oil storage tanks are underground not far from one corner of the station.

A closed cooling water system is used with raw water cooled by a Marley tower and raw makeup taken from the city water system. Soft water makeup is taken through a Permutit Zeolite softener. A 300 gal. elevated balance tank on this system is shown in Fig. 1 just below the crane rail at the far corner of the room.

The Sims heat exchanger on the cooling water supply is shown by Fig. 3 against the far wall directly below the Allen-Bradley motor starters. These four starters are for the soft and raw water pumps which are installed in duplicate. Push button starter stations are provided at each motor. On the suction of the raw water pump, and visible in the foreground of Fig. 3, is a Minneapolis-Honeywell temperature controller which regulates the raw water to the heat exchanger so as to keep a constant temperature off the engines. Each engine is also provided with an Aquastat which sounds an alarm in case of excessive cooling water temperatures.

All four pumps are F-M, 3 in., 1750 r.p.m. centrifugals with a capacity of 450 g.p.m. at 60 ft. head and driven by 10 hp. motors. The 250 lb. starting air compressor is a F-M unit consisting of a 3¾ by 3⅜ in. compressor V-belted to a 3 hp., 1735 r.p.m. motor. A gas engine driven standby unit is also provided.

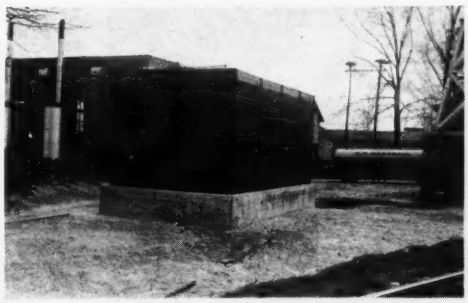


Fig. 2 (Right). Pumps, water softener and heat exchanger are grouped in one corner of the plant in a compact arrangement. For simplicity, convenience and low cost much of the piping is exposed with a minimum run in trenches below the floor level

Fig. 3 (Left). A rear view of the plant showing the arrangement of the mufflers and cooling tower. The structure at the extreme right is one of the water works deepwell pumps, the water works building itself being outside the photograph at the left. Between the cooling tower and oil truck are two 10,000 gal. underground fuel tanks

HIDDEN CORROSION

MODERN BOILERS are usually constructed according to accepted safety standards in such a way as to permit cleaning internally and externally. However, some boilers are installed so that practical cleaning and inspection of many parts is difficult or impossible. Some states have laws specifying periods when boilers shall be completely stripped for inspection of concealed parts but the majority have no such requirements. What the frequency of complete exposure should be is a matter of judgment, although, whenever there is suspicion that weakness exists, these parts should be exposed.

As a general rule it is recommended that where there are conditions tending to promote corrosion, the boilers should have the insulation, brickwork, and other covering removed at least every 5 yr. This is especially true of boilers exposed to the weather, in poorly constructed buildings where water leaks on the brickwork, or where the brickwork is subjected to moisture from the blow-down discharge and from some other source.

Before the boiler surfaces are re-covered, following an examination of this kind, the valuable protection can be given them by applying a suitable coating of moisture-absorbing material next to the surfaces or beneath the usual insulation of masonry or magnesia bricks.

Whenever possible, however, a program of rearranging the setting permanently so that hidden surfaces can be readily examined during a normal shutdown period, should be given serious consideration. Where this cannot be done, frequent and periodic inspections are the only solution. *The Locomotive.*

A DECADE OF PROGRESS IN THE

This ten-year review of the use of electron tubes applies strictly to the use of tubes in other than the communication field. It is one of two papers prepared as reports by the AIEE Joint Subcommittee on Electronics, presented at the AIEE Summer Convention at Swampscott, Mass., June 24-28. The other, by S. B. Ingram, applies specifically to the types and applications of tubes in the communication field.

By W. C. WHITE

THE PAST TEN YEARS include nearly the whole period during which electronic tubes have been used outside the communication field. The types of tubes used in this field may be classified into groups, each having properties that make it valuable in certain phases of industry or in specific applications.

In comparison with the communication field, the use of electronic devices in other industry has played an entirely different role. In communication in general and in radio in particular, tubes and tube developments have been basic to most improvements, truly called the "heart" of nearly all radio apparatus. In industry, however, they have in general had to supplant other methods and to compete in highly developed fields of electrical engineering.

Must Pay Their Way

Use of tubes in the non-communication field has passed through several broad phases. At first they were looked upon with a certain amount of mistrust as being rather fragile playthings entirely unsuited for the severe conditions encountered in the industrial field. Next, as a result of the increased popular interest in science and the optimism of the late twenties, they became "wonder" devices and their wide use in nearly every electrical field was freely predicted.

Within the past few years, a more realistic viewpoint has prevailed and much solid progress has been made. It is realized that there is no magic in the electron tube, and the tube must either accomplish something that cannot be done by any other means or make its own way against competition solely on the basis of what it can do for less cost than existing methods.

Electrons are now known to play such an active part in so many devices that, in the interest of brevity, certain devices are not included in this review. These omissions are neon lights as well as other gaseous light sources, ultra-violet tubes, X-ray tubes, pumped mercury arc tanks, iron wire ballast tubes, mercury and vacuum switches, and uses in phonographs and talking moving pictures. This review is also limited to American references in the interest of brevity.

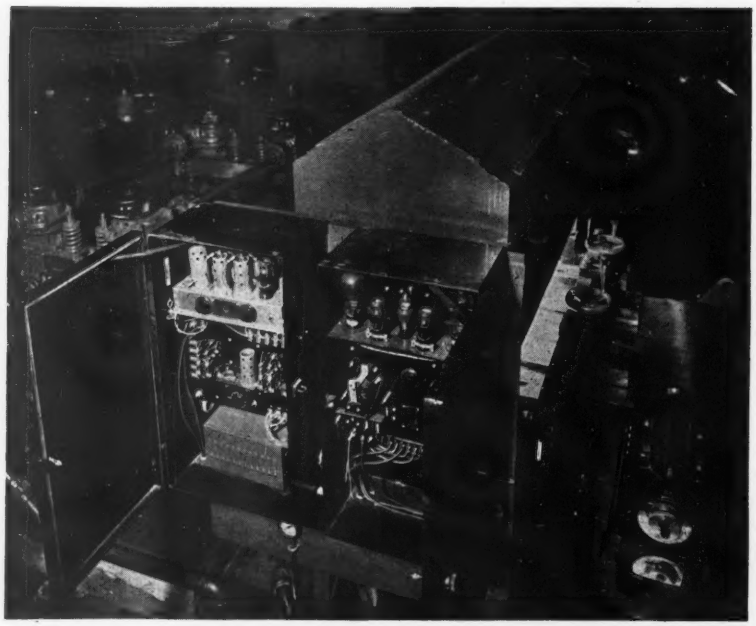
The emphasis in this review has been placed mostly on tube applications rather than the tubes themselves. This has been done because of the wider interest in applications and because the review must be kept to a reasonable length.

Tubes in Industry

In competing with rotating equipment, the use of tubes eliminates noise, vibration, and the need of special foundations. The ability to amplify from very low input levels both in high-vacuum and gas-content tubes makes them unique electrical devices. Their application can also be made continuously variable rather than step-by-step and they provide cycle-by-cycle and fractional-cycle control.

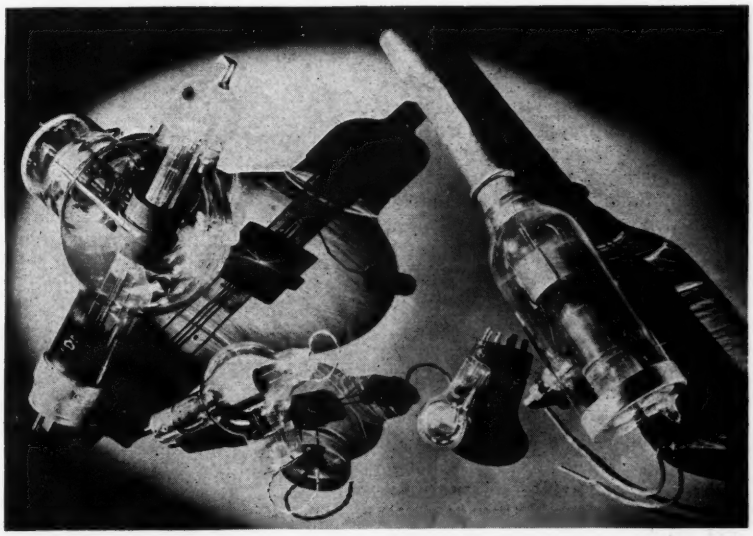
Tubes in combination with such devices as thermocouples, microphones, photoelectric cells, and movable capacitance plates permit electrical response to temperature, sound, light and motion. Therefore, they extend control operations to variations in sensory response.

Tubes also find ready application where they extend certain factors to extreme limits. Timing to



Today tubes occupy a place alongside the heaviest machinery in industry

USE OF ELECTRON TUBES



High Vacuum Tubes, the aristocrats of all electron tubes—the oscillators and amplifiers of industry and the communication field

very short intervals, response to extremely small electrical quantities, and control from very small movements are examples of this. They operate relatively independent of frequency in comparison with most other electrical devices.

All of the above factors are favorable to the use of tubes in industry. However, the relatively high cost of tubes in combination with the fact that they are renewable items has retarded their application; their mode of operation and application, furthermore, has not been as commonly understood as other electrical devices. Considerable engineering knowledge and effort are often required to work out a new application successfully and in some cases the expense of this apparently cannot be justified from the viewpoint of available business.

Summary of Types

High-vacuum Diodes are inherently rectifiers only and are suitable for use where high frequencies are involved. Their use is also limited in general to currents of about an ampere. They are suitable, however, for voltages up to the hundreds of thousands.

Early applications of this type of tube were for the purpose of obtaining high voltage (25 to 150 kv) for smoke and dust precipitation as well as high-voltage cable testing by power companies. This use has continued and grown to some extent. They also find a wide variety of application, but in limited quantities, in laboratories for high-voltage, low-current, d-c power supplies.

High-vacuum tubes with control grid or grids as a class of tubes involves one or more control electrodes; their chief functions are as amplifiers and oscillators. They range in ratings from less than a watt to over 100 kw.

There are probably hundreds of thousands of these tubes in daily operation in a bewildering variety of circuits. By far the big majority of them are radio receiving tube types used in oscillating and amplifying circuits. In some cases, requirements of power output or a special operating condition has dictated special types. Automatic train control, high-frequency therapeutic oscillators and low-grid current amplifier tubes are examples of such special designs.

Hot cathode gas-filled diodes are utilized for rectification of heavier currents at lower frequencies and voltages than the high-vacuum type. Gas-filled tubes have a relatively low and constant voltage drop in comparison with high-vacuum tubes.

There is one field where the great majority of tubes of this type are used and that is for low-voltage battery charging. Most of these are tungsten filament, argon-filled tubes for currents under ten amperes, and for d-c voltages under 125.

Another group of rectifier tubes of this class utilize mercury vapor and are suitable for voltages up to about 20,000. Although the great majority of such tubes are used for d-c power supply of radio transmitters, some are used for high-voltage testing and to supply d-c for high-frequency tube oscillators.

Hot cathode grid-controlled gas-filled tubes or Thyratrons differ from the high-vacuum type in that only the start of the discharge is controllable. They are particularly suitable for controlling currents of a few amperes from alternating-current circuits. Their ability to control by cycles of the alternating-current supply leads to a number of valuable applications.

One of the earliest commercial applications for this type of tube was for the control of the illumination from incandescent lamps used in theatres and decorative lighting. In this application they functioned as controlled rectifiers to supply a variable direct current to saturation reactors. These latter functioned as variable reactors in series with the groups of lamps.

General Application

Within the past few years, applications have fallen largely into certain classes:

(a) Rectifiers to supply variable voltage or current from an a-c source of supply. This combination is employed to control d-c motors, field excitation of generators and various electro-magnetic devices.

(b) Inverters to supply either constant or variable frequency a-c power (up to a limit of a few hundred cycles) from a d-c supply. As a variation of this the same general principle may be used for frequency changing.

(c) The use of a pair of tubes

connected "back-to-back" so that in combination they pass alternating current. This gives a circuit element that not only acts as a contactor but by phase control of the grid voltage permits variation of the current passed. These tubes are so used in some welding control circuits where too large currents are not involved.

During recent years there has been a trend toward the use of inert gases, such as argon, neon, or xenon, to replace mercury vapor. This gives this class of tubes a freedom from ambient temperature effects that are sometimes troublesome with the use of mercury vapor tubes. They are, however, not usable for peak inverse voltages up in the thousands as in the case of mercury vapor tubes. For small tubes to handle fractions of an ampere, the inert gas content also allows operation as an inverter up to thousands of cycles.

Cold cathode glow discharge tubes are particularly applicable where filament operating power is not available and where ample control voltage can be employed. These tubes are often equipped with control electrodes. They are characterized by a higher voltage drop than the hot-cathode or pool type of gas content tube. Also the current carrying capacities are limited to a fraction of an ampere average current except that currents up to a hundred amperes or more can be carried for very short periods of time.

The two-electrode form has a number of applications that may be classified as follows:

(a) As a discharge tube to break down at some abnormally high voltage and thus act as a circuit protective device.

(b) As a voltage regulating device to place across a circuit. This use results from the characteristic of such a tube, with proper design, to pass a wide range of currents with a nearly constant voltage.

(c) As a negative resistance element to generate oscillations by the relaxation circuit principle.

(d) As a rectifier based on the dissimilarity of the two electrodes.

(e) To produce light in accordance with the pulses of current through the tube. The light produced may be extremely intense for a very short time as for stroboscopic work or modulated in accordance with a variable current intensity or frequency.

When one or more control electrodes are added, the characteristics of a relay are gained. The applications listed above are retained and in some cases their scope extended. To date the three-electrode form has largely found its usefulness in the communication field but has wide relay possibilities in industry as it becomes better known and further developed.

Phototubes

In industry the phototube is performing many functions not possible by other means. In addition it is becoming an important agent in eliminating routine human effort. In combination with an amplifying tube, it is finding its place in applications where the eye and the hand are needed but not the brain.

During the past ten years, phototube applications in great numbers have been made and, due to their apparent news value, widely publicized. Development of the phototubes themselves has been along the lines of smaller size, greater sensitivity, selective response in the spectrum and novel mechanical designs for special applications. Lowered cost has also been helpful in extending their use.

Their applications may be grouped into three general classes:

(a) Applications in which a light beam, when interrupted or established, actuates a photoelectric relay. Examples of this are sorting, counting, door opening, hole detection, alarm systems, safety devices and miscellaneous control jobs in industry.

(b) Applications where the tube and its accessories are actuated by variation in the amount of light falling upon it. Examples of this are smoke detection, check on turbidity of solutions, photometry and radiation measurement.

(c) Applications utilizing the difference in response of phototubes to light from different parts of the spectrum either directly or by the addition of filters.

Phototubes may be grouped according to the combination of features they employ. These classifications are:

(a) High-vacuum or gas-filled to increase their sensitivity.

(b) Nature of photo-emissive surface which controls sensitivity and response to different parts of spectrum including the ultraviolet.

(c) Design and composition of bulb to transmit or restrict light flux from different parts of the spectrum to the photoemissive surface.

(d) Variations in mechanical design to adapt the phototube to special uses involving size, nature of base and direction, and degree of solid angle from which radiation reaches the photoemissive surface.

Existing phototubes have various combinations of these features. Photovoltaic cells and selenium cells have not been considered within the scope of this review.

Pool Tubes or Ignitrons

The outstanding characteristic of the pool cathode is its ability to pass very heavy currents—thousands of amperes. The addition of the ignitor gives the pool tube control characteristics. By phase control, voltage and current regulation are obtained and, by cycle control, short time switching functions.

For a considerable number of years, preceding about 1933, the sealed-off pool type of tube had been slowly experiencing a decline in usefulness. Its chief applications were battery charging and high-voltage rectification for series arc lamps for street lighting. These were not growing applications. Then two new developments appeared which changed this picture completely. One was the ignitron and the other was the sealed steel envelope. The first solved the starting problem and gave the pool type the equivalent of grid control. The latter made large tubes and water-cooling practical and the tubes more acceptable to industry.

Since 1933 the use of pool tubes has grown steadily. Most of this growth has been in the welding control field where the tube's ability to carry very heavy peak currents has been an all important factor. The use of the sealed-off steel envelope ignitron for power conversion rectifiers for outputs between 75 and 350 kw. has begun and appears to be a promising field.

Cathode-Ray Tubes

In industry the use of a fine beam of electrons to produce and control a light spot on a fluorescent screen for oscillographic purposes is most common. These tubes can also be used for various forms of indicators.

For many years cathode-ray

tube oscillographs were considered as laboratory devices only but now they are commonly employed by electrical engineers and are necessities for many measurement problems. A better understanding of them, together with better designed equipment and lowered cost, have been the chief contributions.

HE COLLECTS FUSES

By GEORGE E. HAWKINS

AS AN ELECTRICIAN'S HELPER and working on a job one day, I came across an odd looking electric fuse. It was a different type of a fuse than I had ever seen before so I took it home with me.

The fuse was made with a brass screw-cap top and was dated 1892 General Electric Company. The cap had to be screwed off the top to tell if the fuse was good or blown.

This fuse led to my starting of a hobby of collecting old makes of electric fuses. The collection now consists of over 200 different makes of fuses and is the only known one of its kind.

Some of the old make of fuses in the collection were used by consumers for 30 years or more. The fuse that I use myself in my home has been in continuous service for over 40 years and is still as good as new. Guess this makes me the user of the oldest electric fuse in service.

Some of the fuses in the collection were made of agate with the tops filled in with plaster, the consumer having no way of telling if the fuse was good or blown.

Some of the fuses are made of china with web tops the shape of a basket and filled in with plaster.

There are big black, heavy fuses in the collection, the shape of small trap drums with small gummed labels on the top giving the amps and volts. The name on them is Economy, made in Chicago.

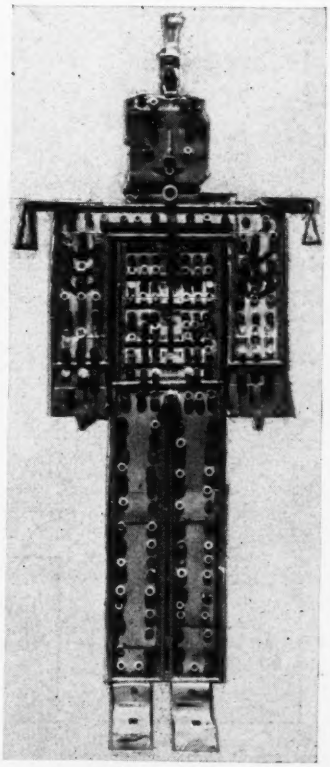
There are brass top fuses with quarter inch glass top windows made by Bryant. There are Metropolitan fuses, Eagle fuses, Weber fuses, Shaw fuses, General Electric fuses, Force fuses, Detroit six-way fuses with a knob on top so that if number 1 blows you can turn the dial to number 2 and on up to six.

Some of the fuses are Union fuses, Blue Ribbon, Clear-Site, Bright Light, Broadway, White Light, Good Light, Safety Light, Security Light, Liberty Light, Yanky, Acme, Safety, Window View, Glass View, Mica View, Clear View, and many others.

Some are made with brass tops, plaster tops, china tops, glass bull's eye tops, pyrex tops, soda-glass tops, agate tops, tin tops, aluminum top, stainless tops, etc.

The fuses are mounted on the front of a giant-size man robot form which stands 8 feet tall and a yard wide. He even has an antique fuse set in the rings on his fingers.

Each eyeball is a fuse, there's one between his teeth and he sports fused ears. The stripes on his uniform coat are fuses as well as his trouser stripes. Yes, the old boy is well protected from being left in the dark.



Old Man Fuse

The latest fuse to be added to the collection is a new type of fuse that Nat Jones of Memphis, Tenn., sent me. It is the first fuse used by Jones, who was the first TVA customer. Guess it will get along okay with the old timers who have seen years of active service on utility networks from coast-to-coast.

REVERSED POLARITY IN D.C. GENERATORS

By Carl Egerter

IN MANY POWER plants compounded d.c. generators, when operated in parallel, are connected to obsolete switching gear. By this I mean that no means is provided to care for reversed polarity. In the case described here a compound generator reversed its polarity even though it was compounded cumulatively. This generator was aboard a ship and it operated satisfactorily in parallel, till one of the generators commenced to spark and the commutator bars developed a bluish appearance.

With the assistance of the chief engineer I found that one generator ran as a differential motor and drew current instead of producing current.

We stopped the machine, reversed the leads and ran a line from the switchboard to the field coils. In this way in about 10 minutes we restored the residual magnetism effectively. This trouble was caused by a fly wheel governor which operated improperly.

Reversed polarity is encountered in new machines as well as old ones. The cause for it, if not due to the governor, is that an operator is liable to put the second generator on the bus bar at a time when it has not attained the necessary speed to generate effectively.

To bring the generator's residual magnetism to normal, the inserting of cardboards under the brushes is deemed expedient. Following this several good shots of currents from the board, by closing the switch, brings the armature to normal speed.

A precaution to be observed is to bring the machines up to the required speed and then close the switches for the respective machines. After that, close the main switch and connect them to the equalizer bars.

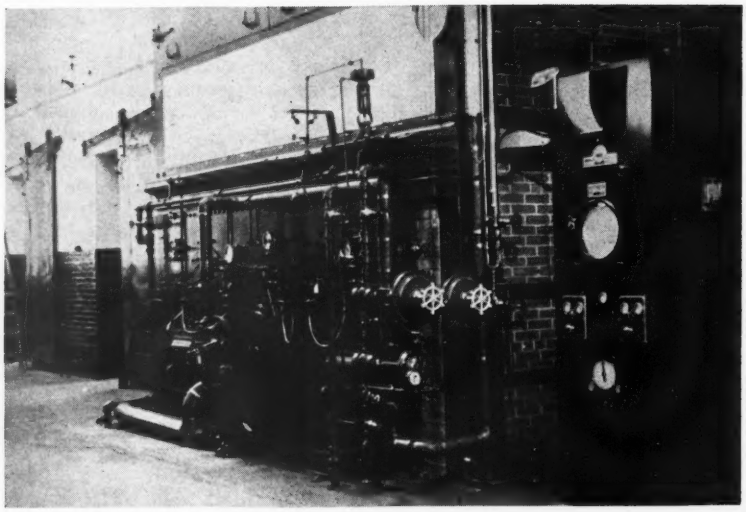


Fig. 1. The new oil burning boiler is under complete automatic control

A New Boiler For Morse Twist Drill

"WELL, what do you think of our new boiler plant?" asked W. T. Read, President and Treasurer of the Morse Twist Drill and Machine Co., as we visited him in his office in the New Bedford factory after inspecting the boiler plant.

Very nice, we told him; we liked it.

"We think it is a pretty good plant ourselves," continued Mr. Read. "It is not unusual and we have done nothing out of the ordinary but it serves our purpose very well. We like the new boiler; the old ones gave us good service for many years and so, when we had to buy a new one, we selected a unit of the same make."

This sincere and obvious interest in the boiler plant of his factory by the chief executive of a large and well-established manufacturing concern was refreshing because only too often the power plant is nothing but a necessary evil in the minds of executives and their interest in it is superficial. Mr. Read's interest, however, was very genuine.

The Morse Twist Drill and Machine Co. is a name that had long been familiar to us; Morse twist drills had been familiar objects as long as we could remember and our visit to the factory at New Bedford, Mass., was, therefore, of more than mere editorial interest.

We mentioned this fact to Mr. Read and he appeared pleased.

"Well, our factory here is an old one," he said. "We have been in business for many years and have expanded our facilities as the need grew. I visit other factories occasionally; in some the raw materials stream in at one end and at the other end the highly standardized and uniform products leave, ready for shipment. These plants are modern, streamlined and efficient and I sometimes think that I would like to have our plant like that.

"But then, again, I will see a factory like that practically closed down temporarily and I ask, why? "Oh! they tell me, a machine part or something on the production line broke down so the whole system has to stop until it is fixed."

"So, then, I feel that perhaps our plant is not such a bad plant after all. Here we make and stock some 15,000 different kinds of items and that does not lend itself well to production line methods. We use the most modern machinery, but our production methods are numerous and varied. A temporary breakdown in one part of the plant has little effect on other parts.

"What do we need so much steam for? Mostly for forging and

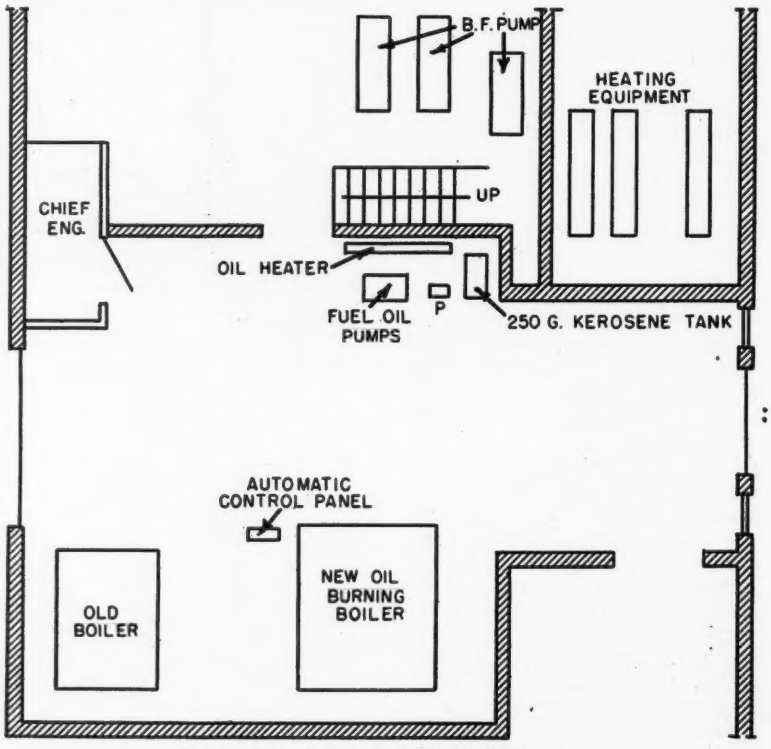


Fig. 2. General arrangement in the boiler room

heat treating. We have a large number of steam hammers. Steam is also needed for building heating in winter, for heating water, for pumping and for refrigeration."

We had noticed the refrigerating equipment close to the boiler room and Mr. Read explained that that was used to cool brine and oil for temperating and for cooling drinking water.

Before the new 127,000 lb. per hr. B.&W. integral furnace boiler was installed a year ago, steam was produced by three old hand-fired B.&W. boilers. These operated at 125 lb. pressure, and while they had given excellent service, they were reaching the end of their useful life; so the new unit was purchased and installed, oil fired and under complete automatic control.

This change turned the boiler room from an inevitably dusty and unkempt place into the spotless, well-ordered room you see in the photograph, (Fig. 3). The brick walls are painted flat white with a brown wainscoating about 5 ft. up from the floor. The latter is of concrete, painted grey. All piping is covered with magnesia insulation bound with polished brass bands.

The fuel oil pumps and heaters are mounted on the floor directly opposite the new boiler. The oil is heated to about 210 deg. but for starting a 250 gal. tank of kerosene together with a small rotary pump is provided. The kerosene, of course, needs no heating.

Although the new boiler is built for a working pressure of 200 lb., at present the unit is operated at 125 lb., the same as in the case of the old boilers. This is ample for the forge hammers and the heating processes. The buildings are heated by a hot water system from three heat exchangers and a group of three steam turbine driven circulating pumps.

Other features of the plant are shown by the photographs and details of the equipment are given in the list of equipment. As Mr. Read pointed out, a boiler plant of this type presents little that is unusual but it is well designed and fulfils its purpose to a high degree. The automatically controlled oil fired boiler is a particular joy and represents an outstanding improvement over the old, hand fired boilers; William H. Rowand, the capable chief engineer, can testify to that.

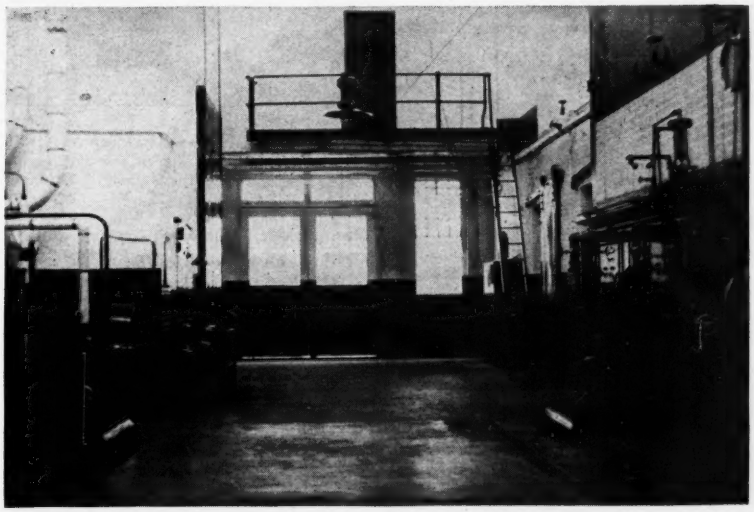


Fig. 3 (Above). A view in the boiler room showing the new oil burning boiler at the right and the fuel oil pumps and heaters at the left

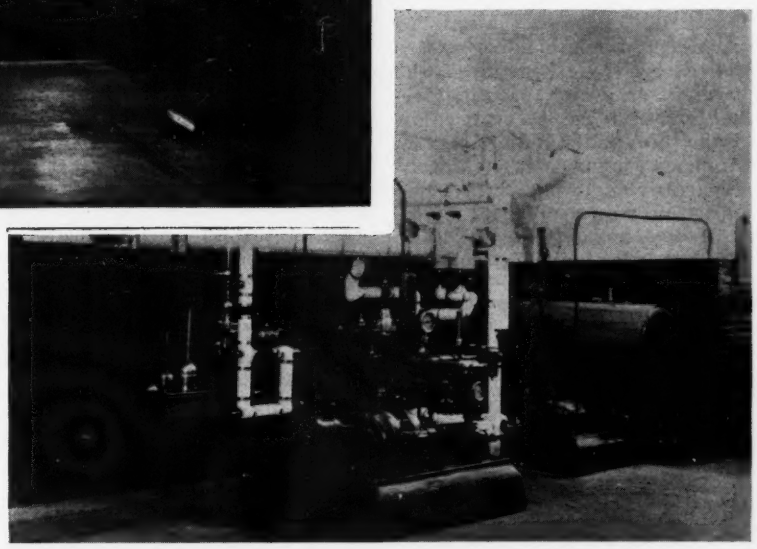


Fig. 4 (Right). The fuel oil pumps and heaters. The 250 gal. kerosene tank used in starting is shown at the right

The Equipment

BOILER. Babcock & Wilcox Co., cross drum, integral furnace, oil fired, built for 200 lb. press., 325 deg. F. steam. Capacity 127,000 lb. per hr.

COMBUSTION CONTROL. Bailey automatic control system. Consists of control panel together with devices for controlling draft and fuel feed.

FUEL OIL PUMPS. 2—1 steam driven, 1 motor driven. Motor driven unit is a rotary made by A. M. Lockett & Co. and driven by a 2 hp. General Electric 850 r.p.m. induction motor. Steam driven pump is a Worthington duplex reciprocating pump.

FUEL OIL HEATERS. 2 Griscom Russell heat exchangers heated by exhaust steam.

FUEL OIL STRAINERS. Coen Co. (San Francisco) twin strainers.

OIL METER. Buffalo Meter Co.

OIL TEMPERATURE CONTROLLER. Powers Regulator Co.

OIL PRESSURE GOVERNOR. Fisher Governor Co.

FORCED DRAFT FAN. L. J. Wing Mfg. Co. Steam turbine driven fan set in front wall of furnace below the burners.

AIR COMPRESSOR. 2 cylinder Christensen Eng. Co. (Milwaukee) unit, V-belt driven by 3 hp. Westinghouse motor. For combustion control air supply.

FEED WATER PUMPS. 2 Worthington duplex steam driven units.

FEED WATER CONTROLLERS. Bailey Meter Co.

BLOW OFF VALVES. B.&W. and Barrett Machine Co.

VALVES. Boiler valves—Chapman Gate valves. New Bedford

Boiler & Machine Co. automatic valves. Crane and Jenkins valves on Fuel Oil System.

SOOT BLOWER. Diamond Power Specialty Co., Valv-in-head.

SAFETY VALVES. Consolidated.

HOT WATER CIRCULATING PUMPS. 1 Gould Mfg. Co. unit driven by Lee turbine. 1 LeCourtney driven by Terry turbine.

FUEL OIL. Bunker C (No. 6) oil used normally.

FEEDWATER. Feedwater is city water, treated chemically and heated to a temperature of 180 deg. in a National feedwater heater.

GEARED FOR DEFENSE

We can't give you a cruise on a battleship but here's the next best thing—A word picture of what puts the pep in the Navy and a personally conducted trip around a modern factory working on vital defense needs—all without work, too. You may not give a whoop for gears but you'll like this story

By A. A. Ross*

Engineer, Gear Eng. Dept.
General Electric Company

Fig. 1. Here is the hobber which cuts teeth into the huge bull gears. Made of tungsten steel, it nearly equals the diamond in hardness

BUILDING a two-ocean navy to protect Uncle Sam's coasts as well as his trade has turned the spotlight on every phase of shipbuilding. Not the least important is the production of propulsion equipment, upon which ships at sea are as dependent as a plane off the ground is upon its motor.

Most of today's ships building and on order will be equipped with turbine-gear sets: turbines because they are the most efficient large steam prime mover known; and gears because the high revolving speeds at which turbines operate best must be reduced to the relatively slow speeds at which a turning propeller will bite into the water at maximum efficiency.

At the present time the company is manufacturing or has on order propulsion gears for naval and merchant ships totalling more than 3,000,000 hp. The reduction gears of these equipments, because of their enormity and the extreme accuracies to which they must conform, are as fascinating in manufacture as they are vital in the function they perform once they are installed on shipboard. Their production requires the utmost in precise machining and carefully coördinated fabrication. Tolerance of the gear teeth, for example, are measured not in hundredths or thousandths of an inch, but in tenths of thousandths of an inch. And these are gears which weigh as much as 70,000 lb. and run up to 200 in. in diam. Think of such monsters being machined to an allowable error less than a fraction of the thickness of a cigarette paper!

Naturally, their manufacture requires special manufacturing facilities. Two mammoth shops at General Electric's Lynn River Works are now being expanded in a $3,000,000 program which will nearly double the company's facilities for producing reduction gears. These extensions will be completed early in 1941. An additional $8,500,000 is being spent in increasing the Company's facilities for manufacturing marine turbines by equipping an existing shop at the Erie Works for the production of light cruiser and destroyer units. Larger turbines for battleships are produced at Schenectady.

About ten months is required to manufacture the largest gear sets. The time might be reduced at the expense of some of the precautionary measures exercised in every step of production, but the one or two months gained would be poor economy. Experience has shown that constant care and thorough checking during manufacture eliminates trouble once the units are installed on shipboard. Such units literally make cruises out of grueling trial runs which unfailingly show up defects if sets are less carefully made.

*Past President, American Gear Manufacturers Association.

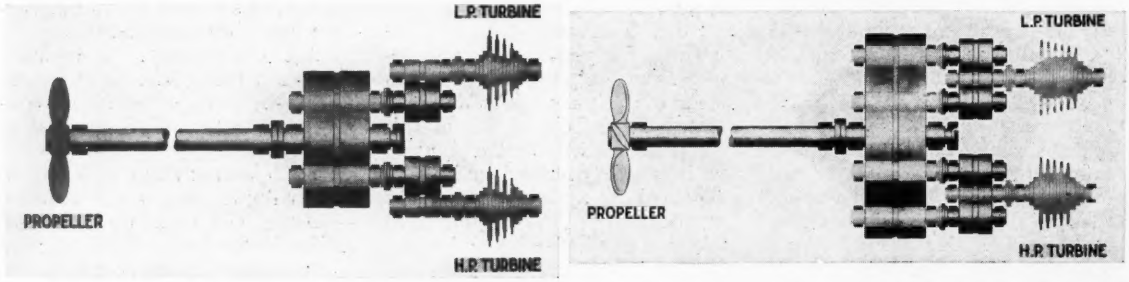


Fig. 2. This is the way the power plant goes together. The pictorial diagram at the left is a popular cargo boat type, that at the right is the geared turbine arrangement for destroyers and battleships. Note the four high speed gears on the latter to give increased shaft horsepower

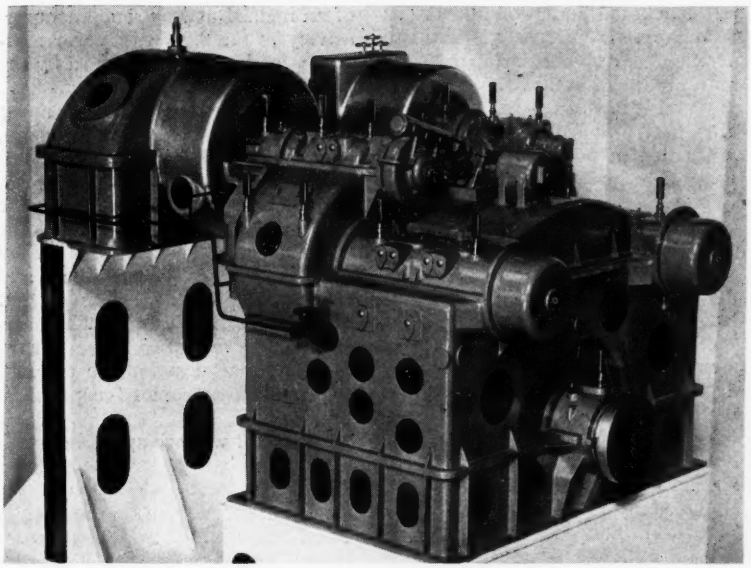


Fig. 3. This is the way the complete job looks ready for a merchant vessel. Turbines are at the left; the shaft from the bull gear ready for connection to the propeller shaft is shown at the lower right

Most important of all, of course, is the necessity for absolute reliability of operation at all times, which the propulsion unit of a ship can provide only if it has been built to near-perfection. A power plant 1000 mi. out at sea is a pretty hard animal to fix if it gets out of kilter. Needless to say, such a failure could be mighty embarrassing for a naval combat ship.

The steam turbines which turn a ship's screws through the reduction gears are pretty steadfast brutes and they are manufactured with care as great as that taken for the gears. They operate best at high speeds of from 4000 to 10,000 r.p.m. Propellers, on the other hand, are most proficient when they are turning between 75 and 400 r.p.m., depending on the type of ship. Thus the necessity for the reduction gears connecting the two. Generally the turbines are of the cross-compound type. The ahead turbine is a high pressure and low pressure unit in series. The astern turbine, of only a few stages, is located in the low-pressure turbine casing and develops from 30 to 40 per cent of the power of the ahead turbine.

Merchant vessels now being made in the U. S. are mostly tankers and cargo vessels powered with turbines rated 3000 to 12,000 hp. They have large, slow-speed propellers and operate continuously at full power. Gears for units on these ships must be rated conservatively, that is, tooth pressure is comparatively low.

Naval combat ships, usually of small displacement, are fitted with turbines of from 25,000 hp. upwards. They have high propeller speeds and seldom operate at full power. Gears for these ships are more liberally rated, and weight reduction is an important factor.

A propulsion set for a battleship weighs in the neighborhood of 300,000 lb., of which the gear unit accounts for two-thirds. The low-speed gear itself weighs about 70,000 lb.

Consider for a moment the significance of these facts. Ordinarily, the need for extreme accuracies becomes less and less as the size of an equipment increases. One would not think of a locomotive being made as carefully as a fine watch. Yet here is an equipment tipping the scales at up to 150 tons, made so its parts function as smoothly as a delicate timepiece. Obviously, the very nature of reduction gears and the manner in which they transfer the fast turning turbine's energy to drive the propeller at the desired speed means that any defect they might have would tend to magnify itself. A mental picture of the gear arrangement will help understand why.

Starting with the propeller shaft and working back to the turbine, the first gear encountered is the low speed gear. This is the giant of the set, of the 200-in. diam. variety. Seamen refer to it as the "bull" gear. The bull gear is engaged by low speed pinions, two of them on a merchant ship and four on a naval vessel. The latter type ships also have four high speed gears to the merchant's two. The net result of the arrangement is more shaft horsepower for the naval vessel at no more appreciable increase in weight, providing power for the sustained higher speeds sometimes needed by the combat ships, but not required by merchant vessels.

Flexible couplings connect the low speed pinions to the high speed gears. The high speed gears are engaged by high speed pinions, connected to the turbines through flexible couplings. This arrangement prevents strains being transmitted from one unit to another from slight misalign-

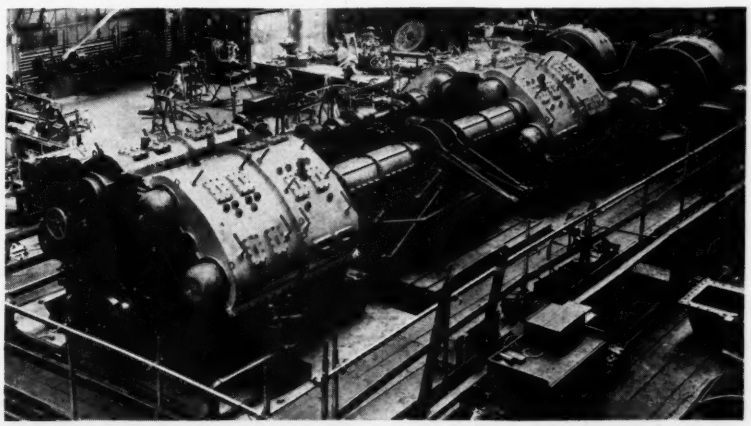


Fig. 4. In the shop they are tested like this. These are gears for a naval vessel set up back-to-back. Motors at extreme right drive the bull gear of one of the sets. The shaft connecting to the other set is deflected slightly to make pressure on all gear teeth of both sets similar to full load conditions. Sometimes the turbine and gears are tested as a unit, a generator being used in place of a propeller to absorb the output

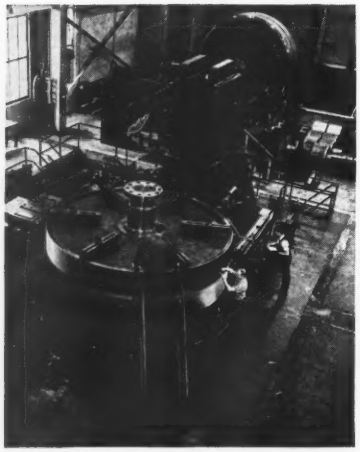


Fig. 5. Teeth being cut into a 163-in. bull gear in the hobbing shop. About 85 hr. are required to make the one rough and one finish cut for each of the two rows of teeth. No interruption is permitted during the finish cutting

ments in operation, plus giving axial freedom for the various elements. The gears are not all on the same plane.

They are stepped down so that the bull gear is astern and below the turbines. Reduction in speed of revolution from turbine to propeller achieved through the reduction gear arrangement is as high as 85 to 1 in some cases. The entire gear arrangement is held together and kept engaged by a great casing.

Let's go back to the shop and see how the manufacture of the gear set and its casing is coordinated to obtain an overall smooth-functioning unit.

Bull gears and casings require equal time in manufacture, about 8 mo. Manufacture of parts needed in the fabrication of each, as well as the other gears, pinions, couplings, and other components, must be thoroughly coördinated in order to dovetail into a complete gear set on schedule.

The bull gear is made of six pieces; a hub, which will fit it to the shaft; four webs, big steel disks which compare to the spokes of an ordinary wheel; and a tire, into which, on a 200 in. bull gear, will be cut as many as 600 teeth.

The hub is a steel casting and the tire is a single forging; the webs are made of rolled plates. Each of these parts is rough-machined before assembly. They are welded together, hot, into a single unit, and lowered into a large oven and strain annealed.

The wheel is now ready for its shaft. The shaft is a single forging, machined and ground. It has been tapered very, very slightly to match a corresponding taper in the hub of the wheel. The two are joined by lowering the shaft into the wheel, and applying a carefully controlled pressure to make the fit permanent without setting up any strains.

The embryo gear is then machined to its own journals, dynamically balanced, and it is ready for the hobbing shop. Hobbing, or cutting the gear teeth, is done in a special shop where temperature is maintained constantly within five deg. of 72 deg. F. Their entry into the big controlled-temperature hobbing shop is usually preceded by hours of cooling or heating in a special ante room.

Once inside the shop proper, the big wheel undergoes a final machining before it is ready for one of the hobbing machines. After a gear has been secured to the table of the hobbing machine, it is not removed until it has been given a double row of teeth. The cutting process itself requires about 85 hr. and once a cut is started it is not allowed to stop, for an interruption might ruin the gear.

Continuous power supply to the giant hobbing machines is protected by an auxiliary power plant consisting of a motor-generator set and storage batteries. Before a finish cut is started, automatic relays are set, and if the main power to the driving motors should fail, the relays cut in and the auxiliary power keeps the machine in motion until the main power is restored.

Four cuts in all are made, one rough cut and one finish cut on each of the two helical rows of teeth. The rough cut belies its name, for it works to a tolerance of thousandths of an inch. But it is rough comparatively to the 0.0003 in. error margin in teeth spacing obtained by the finish cut.

Meanwhile the casing for the gear assembly has been undergoing equally careful manufacture. The most important parts of the casing are those which will support the shafts of the various gears; the bearing seats, or housings. They must be carefully machined and fabricated into the casing so that the gears will ride true. The bearing housings are of cast steel. Drawings and patterns for the castings require almost 2 mo. for preparation.

About 2 wk. are spent in rough cutting the bore before the castings are ready to be welded into the steel plate structure of the casing. Final machining, which requires from 8 to 10 weeks, is not started until the casing has been annealed and checked.

All of the operations up to this point have consisted of fabricating parts separately made and machined into sub-assemblies. This process of obtaining the necessary materials and making them into gears, pinions, couplings, and the casing to house them requires nearly 8 mo.

Actual assembly into a complete gear set, and testing the set before it is knocked down for shipment, requires from 6 to 8 wk. The final factory tests, which simulate the actual operation of the gear sets on shipboard, prove the accuracies to which the various parts have been made, and assure that little or no difficulty will be encountered once installation is made aboard ship.

The sets undergo one of two types of tests. In one the complete

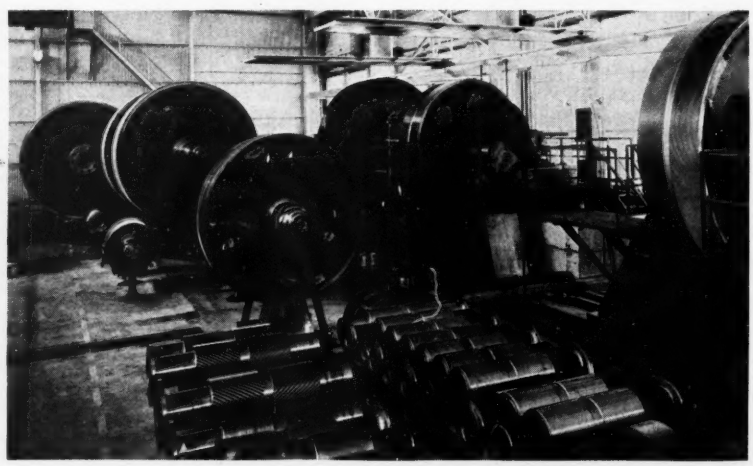


Fig. 6. Spiral gears and pinions in various stages of manufacture inside the hobbing shop

gear unit is hooked up to the turbine which will drive it on shipboard, and operated just as though it were driving the vessel through the water. The only difference is that the bull gear shaft is connected to a generator instead of the ship's propeller.

In the other test two gear sets are placed back-to-back and connected by two shafts. The bull gear of one of the sets is driven by a big motor. By means of a torqing arrangement in which the connecting shafts between the two sets are deflected slightly, the pressure on all of the gear teeth of both sets is made to correspond to that which would exist if the units were being driven at full load.

Throughout the manufacture of the mammoth propulsion sets, the skilled worker is an all important factor. Finish machining of the gear parts is a job which can be done only by workmen accustomed to working to the close tolerances demanded, while the machinist on the rough cut cannot be expected to work to tolerances of 0.0003 in. Conversely, the finish machinist, used to working to minute limits, would probably waste time by doing a rough machining job too carefully like the landscape artist painting a big billboard.

When the extensions to the present turbine gear shops are completed early in 1941, every facility will be coördinated to swing into smooth production. There must be no bottleneck of men, machines, or materials for creating the equipment which will be the heart of America's ships for trade and defense.

EVOLUTION OF THE H.R.T. BOILERS

By C. C. Custer

NEW MACHINES are liable to have "bugs" in them. I hesitate to buy a 1937 model if it is a considerable variation from preceding design. Freak designs are prone to develop defects. It is not always feasible to test a machine to destruction to find its weak points.

Time will, however, tell the story when we study the record of breakdowns and the list of repair parts called for in the maintenance. In this machine age we realize that the designing engineer's work has speeded up and it does not take us so long as formerly to find mistakes and rectify them.

Even so simple a piece of machinery as the horizontal return tubular boiler has passed through what we might call experimental stages in the past 50 yr. The design has, however, now become so standardized that if we buy a code[1] built boiler of any one of a number of manufacturers we would find the boiler built practically the same.

Changes

It is of interest to consider some of these points of improvement in design. Recently I ran across an H. R. T. boiler, 72 in. by 18 ft., built in 1870 and still in use and in good condition, although its pressure had been reduced from 100 to 15 lbs. and it was being used for low pressure heating.

In those days boilers were made of wrought iron as the modern process for making steel had not yet come into use. This boiler was made in three sections as mills were not then equipped for making wider sheets. This boiler had continuous longitudinal lap seams.

The Lap Seam Passes

The lap seam is no longer considered suitable for the longitudinal seam of power boilers. Occasionally some inspector would find a typical lap seam crack and condemn such a boiler for further use. The "breathing" of such a boiler under pressure is liable to produce a bending moment at the joint and cause such a crack. So the lap seam longitudinal joint boiler has been relegated to low pressure heating service, by law in most states.

The factor of safety of the double riveted lap joint is only 70 to 72 per cent, and the double, triple and quadruple, butt and double strap joints are respectively of 82, 87, and 94 per cent efficiency, they make a stiffer joint better able to stand up safely under service. The quadruple joint did not become common till later as of course it was more expensive to fabricate. This extra expense was however offset by the fact that the efficiency of joint is higher so a thinner sheet could be used for the same pressure.

Stresses

The H.R.T. boiler has always had a girth seam of single riveted lap construction. A cylinder is twice as strong in direction of its length as in direction of its diameter. Therefore the factor of safety of such a girth seam is always ample in comparison with the efficiency of the longitudinal seam.

A double riveted lap seam either at girth seam or on fire sheet patch always accumulates fire-cracks and is never successful. The only type of boiler where a double riveted lap girth seam is used is the Scotch-marine type where the joint is not subjected to the flames.

A little later in the history of the H.R.T. boiler when wider sheets were being manufactured, to obviate the prevalence of fire cracks at girth seam some one conceived the idea of doing away with the girth seam entirely by using a single sheet for the lower half of the boiler shell. These single sheet boilers were not as successful as had been hoped for.

Code Changes

The girth joint was found to have a virtue it was not previously given credit for, that is, it stiffened the boiler at the center to keep it round. When tried it was found that many of the single sheet boilers became distorted and out of round where subject to the heat of the fire, so that finally the code was amended prohibiting the use of sheets longer than 12 ft. in the direction of the length of the boiler.

The old boiler aforementioned was equipped with a 6 in. diam. mid-drum and a steam dome.

[1]This reference is to the A.S.M.E. Boiler Construction Code, recognized as the legal standard of construction by most states. Some states which have not adopted it in full have state codes which differ from it only in minor details. A few states have no such code.

Blow-off

Mud-drums were found by experience to be a source of weakness because when the engineer failed to blow them down regularly they would sometimes mud, burn and rupture. The opening of such a large diameter hole would be sufficient in case of rupture to blow the boiler out of its setting, so that finally the code established that a blow off line should not be larger than 2½ in. diam. of extra heavy pipe and should be protected from the flames by a V-Pier.

The steam dome as applied to a H.R.T. boiler was hard to fabricate and fit to the shell and was a source of weakness and so in course of time it was abandoned and the design changed to an increased height of upper segment to give more steam space and the use of dry pipe and baffles to secure dry steam. There are very few old boilers remaining in use that have steam domes.

Stays

Again the old aforementioned boiler had crow-foot welded diagonal stays, evidently fabricated by some blacksmith. It soon became evident that the weld was a weakness and weldless formed stays came into use. Several styles and shapes of stays were successively used, prominently among which were the McGregor Stay, The Huston Stay, and later on, the Scully Stay. Nearly all manufacturers use the Scully Stay, at present time.

There was a time when diagonal stays were used below the tubes at front and back head but this practice was soon found to be a mistake as it was hard to keep the lower sheet clean at the point where the stay was attached to the lower shell and many boilers became bagged or distorted at that place—so that nowadays we depend altogether on through-rods to stay the lower segment.

Safety Valves

Another thing conspicuous by its absence is the old time Arm-and-Lever safety valve. This had no blow back adjustment and was constantly sizzling and leaking and needing grinding in. There was a time when they would allow you to install an arm-and-lever safety valve on the same outlet with the steam nozzle but it was found at times of carrying the water rather high and the boiler popping off it was liable to draw a slug of water over into the steam line to the detriment of any reciprocating engines.

Some of the improvements in the design of the H.R.T. boiler were for the purpose of making the boiler more nearly fool-proof —this is true mostly in regard to the fittings that go onto the boiler. For instance, many of these old-time boilers were equipped to feed in through the blow off pipe. It is impossible to feed in thus and make the blow-off line serve the function of a blow-off and a feed line at the same time for the feed would push the loose scale and mud forward to the fire sheet and if the boiler were not cleaned frequently it would accumulate there and cause overheating and bagging.

Feed Lines

From observation I conclude that most of the patches on old boilers came about that way. There came a time when more sensible methods of feeding was formulated, a feed line to: enter the front head above the tubes; extend backward to three-fifths of length of boiler; cross over to the middle and discharge downward between the tubes so that any mud or sediment will accumulate where it may be blown off.

Another possible accident in connection with a blow-off line is a chunk of scale getting under a valve so that it cannot be closed tight, and the water getting low in the boiler on account of leakage through the blow-off. For high pressures the Code now requires that beside a gate or other type of blow-off valve there shall be a stop cock installed in the line with the end of the plug distinctly marked in line with the passage. This to obviate any doubt as to whether the valve is turned off tight.

Other points of design might be mentioned to illustrate this point—that there are good and sufficient reasons back of the items in the code that seem arbitrary in nature but the wisdom of which is backed up by experience.

Telling the Age

In the absence of reliable data as to the age of a boiler (H.R.T.) —the boiler inspector who is conversant with the changes of design that have come about in the past 40 yr. can estimate the age very closely by noting the peculiarities of design, for instance single sheet boilers were not built after the year 1900, and angle stays to brace the lower segment were taboo after about 1920.

A.C. Does Not Damage Water Pipes

An investigation of 21 cases of American Research Committee on Grounding reveals no evidence of damage due to electrolysis by alternating current. Fifty times as much alternating current as direct current is necessary to produce comparable degree of polarization.

IN INVESTIGATING 21 grounding cases during the past year, the Technical Subcommittee of the American Research Committee on Grounding found no evidence to indicate that the flow of alternating current over water pipes or mains had by itself caused damage to the piping or the water, according to the report presented at the Committee's annual meeting, held June 29, at New York. The committee stated, however, that investigations have not yet gone far enough to prove that such damage could not occur. It recommended continuation of investigation of all complaints of contamination of water where grounding of electrical circuits is involved.

The subcommittee report, which reviewed the progress made during the year, also included the findings of fundamental laboratory studies in polarization and other grounding problems.

The 21 investigations were made in cases brought to the attention of

the committee by associated organizations, and involved studies in seven separate communities.

In one situation involving a complaint of blue stain, studies were of the conditions in five separate houses, all of which were built within the last year or two and were more or less alike in construction and equipment. They all had copper water service pipes from 30 to 50 feet in length, and the interior piping was of copper. There was definite interchange of current over the water system in three of these cases. The principal differences were the use of copper hot water tanks in three cases, and galvanized iron hot water tanks in the other two. Three of the houses, one of them with a galvanized tank and the others with copper tanks, obtained water from a 6-in. cast iron main within about 100 ft. of its end. The other two houses, one each with a copper and a galvanized hot water tank, were at the dead-end of another 6-in. cast iron main one block away. These two subsidiary mains got their water at points less than 200 ft. apart on a 12-in. feeder main. The water supply was derived from two separate deep well sources several miles apart at the opposite ends of the feeder main. The location of all these houses in relation to the sources was such that they would probably receive water from one source during part of the day and from the other source the remainder of the day. One of the sources was treated with chlorine but not with lime, while the other source was treated with lime but not with chlorine. There is some evidence which would indicate that deep well waters may when they are soft and high in free CO_2, if not treated with lime, cause initial corrosion of copper tubing which would result in blue staining. These conditions may become more serious when the hot water is heated to too high a temperature.

Blue Water

The Subcommittee reported on an investigation made in the Middle West where blue water was involved, the condition being so serious as to cause discoloration of food cooked in the water. In this case the local authorities had called upon the power and telephone companies to remove all grounds from the water piping in the residence, and consideration was being given to extending this prohibition. All the grounds were removed, except the one from the frame of the motor driving the oil burner. The condition was reported to have cleared up temporarily following the removal of the ground, but recurred within about a month. At that time the house piping was thoroughly cleaned, after which the condition finally cleared up. During the interval between removal of the grounds and flushing of the piping, a change has been made in the treatment of the public water supply which reduced its iron content from about 2.2 to about .3 parts per million. This treatment of the water supply had been temporarily discontinued during the summer months. The house had been completed and first occupied about the middle of the summer. The conditions in this residence were investigated thoroughly and investigations were made at several other residences similarly equipped but where no complaints had been made of water conditions. Most of the other residences had been built for some while, in contrast to that where the complaint originated. In connection with the investigation the Subcommittee also made arrangements to have the grounds restored one by one and to have analyses made of the water by the State Health Department at two or three-week intervals to determine whether there was any recurrence of the condition complained of. At the time of the meeting of the Grounding Committee, none of the grounds had been replaced. However, advice received later showed that the grounds have been reconnected for some time and no adverse effects have appeared.

In one case involving a relatively new suburban house, a serious complaint of blue sediment in the water was brought to the attention of the Subcommittee. At the time of the investigation a glass of water drawn from the pipe showed substantial blue flakes of copper carbonate at the bottom. The water service pipe was about 250 ft. long and the electric service was about 500 ft. long from the transformer to the residence. The electric service was grounded at the meter to the water service in approved fashion and average interchange of current over the water service pipe was revealed. A modified fish trap with an 80 mesh strainer was installed at the house end of the water service in order to reduce the trouble, and to permit periodic determination of the amount of sediment collected. The amount of sediment fell off to nothing between the late summer and December of 1939. Up to the time of the meeting no sediment had appeared but in the latter part of August, 1940, sediment reappeared. In this case the water supply was treated with chlorine and lime, the latter by means of an unattended automatic liming equipment at the pumping station. It was reported that the lime treatment had been discontinued since June, 1940.

In this case a section of the service pipe was removed for examination and analysis. The interior of the pipe was found to be coated with non-adherent copper salts. It is of interest that at the time of the removal of this sample of the service pipe the plumber reported sparking and electric shock. A subsequent investigation revealed that opening of the service pipe resulted in the development of a maximum of 10 v. between the house end and the street end of the piping during the starting of an electric washing machine. With a steady load of 10 amp. in the residence, the voltage across the open ends of the service pipe was 3 v. This undoubtedly accounts for the sparking and electric shock reported.

The Subcommittee, in its report, again pointed out the unsatisfactory conditions which have been observed at the point of attachments of ground clamps to water pipes. Two general types of ground clamps have been observed, one, the copper strap type, and the other, a cast or wrought iron clamp, generally galvanized. The use of copper straps on galvanized pipes sometimes had led to corrosion of both the strap and the piping in the presence of moisture, due either to dampness in the cellar or condensation on the pipe during warm, humid weather. The moisture sets up a local electrolytic cell between the different metals present. Iron clamps on galvanized piping do not appear to have resulted in any adverse effects. However, the use of large cast or wrought iron clamps on copper tubing or on lead pipe has been a source of trouble due to electrolytic effects, and also mechanical damage to the pipe because of the massiveness of the clamp in comparison to the tubing to which it is attached. Improper installation of such clamps may result in crushing or deforming either copper tubing or lead pipe. The Subcommittee has discussed the development of a type of grounding connection which could be placed directly in the plumbing system at the time of installation, to which all electrical ground connections

could be solidly made without any of the difficulties which have been observed with clamps.

Fundamental Laboratory Studies

The fundamental laboratory studies reported by the Technical Subcommittee were made to determine the polarization effects of alternating current on electrolytic cells. Using a 1/10 normal solution of sodium chloride for the electrolyte, tests were made where both electrodes were copper, both zinc, and also where one electrode was copper and one was zinc. The circuit was arranged so that various magnitudes of direct current and various magnitudes of alternating current either separately or superimposed would pass through the cell. Among the results found under this particular test set-up were:

Zinc electrodes polarize less than copper electrodes.

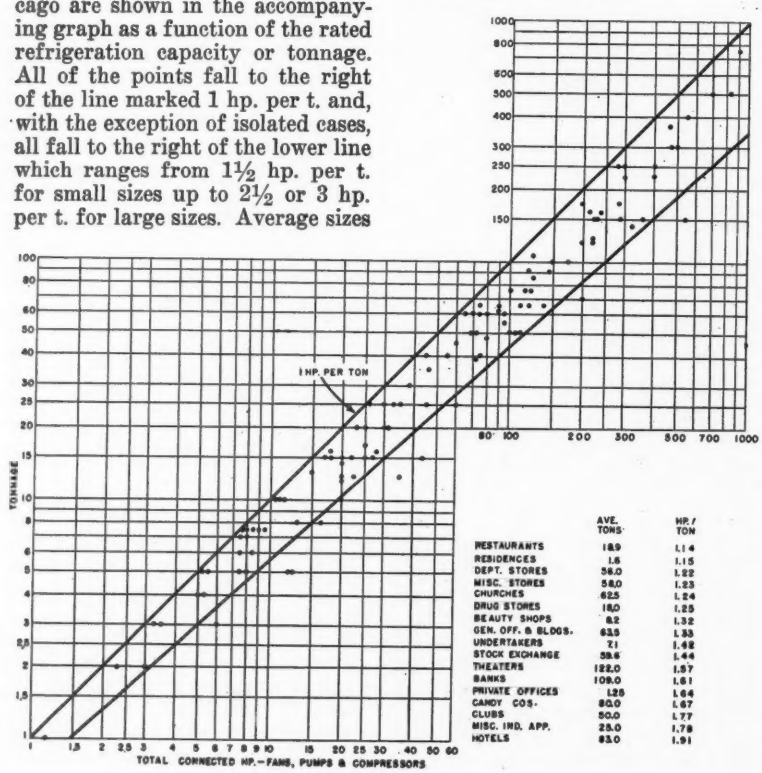
It required about 50 times as much alternating current as direct current to cause comparable polarization.

Summary

In its investigations the Subcommittee has observed differences in the chemical composition of water supply; in the nature of the permissible impurities in the copper tubing installed; in the number and arrangement of galvanic couples resulting from the more or less indiscriminate use of many different metals and variations in composition of the same metals; in the temperature of the hot water supply, in the rate and amount of water drawn from the mains; and in many other factors as well as the possible effect of stray current. It has not been possible thoroughly to develop all of the complex variables present in the different situations investigated and the Subcommittee's work has not progressed as rapidly as hoped for, due to its inability to obtain a sufficient number of cases for investigation. However, the report of the Subcommittee stated that in none of the cases investigated was there evidence to indicate that the flow of alternating current over water pipes or mains by itself has caused damage to the piping or to the water flowing in the pipes. However, the investigations have not progressed sufficiently to prove that such damage could not occur.

HORSEPOWER FOR AIR CONDITIONING

COMPARISON of horsepower requirements for fans, pumps and compressors for several hundred air conditioning installations in Chicago are shown in the accompanying graph as a function of the rated refrigeration capacity or tonnage. All of the points fall to the right of the line marked 1 hp. per t. and, with the exception of isolated cases, all fall to the right of the lower line which ranges from 1½ hp. per t. for small sizes up to 2½ or 3 hp. per t. for large sizes. Average sizes and the ratio of horsepower to tonnage for representative groups are indicated by the tabulation in the lower right hand corner.



	AVE. TONS	HP./ TON
RESTAURANTS	18.9	1.14
RESIDENCES	1.6	1.15
DEPT. STORES	56.0	1.22
MISC. STORES	58.0	1.23
CHURCHES	62.5	1.24
DRUG STORES	18.0	1.25
BEAUTY SHOPS	8.2	1.32
GEN. OFF. & BLDGS.	63.5	1.33
UNDERTAKERS	7.1	1.42
STOCK EXCHANGE	38.6	1.44
THEATERS	122.0	1.57
BANKS	109.0	1.61
PRIVATE OFFICES	1.25	1.64
CANDY COS.	80.0	1.67
CLUBS	50.0	1.77
MISC. IND. APP.	23.0	1.78
HOTELS	83.0	1.91

ENGINE MANUFACTURING

Preliminary figures released by the Bureau of Census show that in 1939, 74 manufacturing establishments turned out products valued at slightly over one hundred and ten million dollars. This production involved 5129 salaried employees with salaries totaling almost nine million dollars, as well as 14,752 wage earners whose total wage earned was twenty-one and a half million dollars. Cost of materials came to slightly over fifty-three million dollars and the value added by manufacture was approximately fifty-seven million. With the exception of the salaried personnel, all of these figures showed decreases from 1927 of from 8 to 30 per cent.

This report covers only establishments whose chief products are internal combustion engines. It excludes aircraft and motor vehicle engines as well as engines for installation in locomotives, ships, boats and tractors when both the engines, locomotives, etc., are built by the same establishment.

Diesel engines for stationary service numbered 6699 with a total horsepower of 667,802. The total value of these engines was nearly seventeen million dollars. Approximately 5500 engines come within the range of 20 to 200 hp., 385 are between 200 and 1000 hp., and 44 were above 1000 hp.

Power Plant Operation Problems

In two preceding articles the author presented a number of operating problems that came up in this municipal plant at Ft. Collins, Col., and described the methods used in solving them. In this final article, Mr. Crain considers some of the elements involved in ordinary operating procedure, those concerned with starting and stopping turbines and in the testing of boiler water.

By RICHARD W. CRAIN

Instructor in Mechanical Engineering
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IN THE two preceding articles[1] a number of unrelated problems were considered and methods of solving them described. Now, in this final article, we will consider a few elements of ordinary operating procedure, that of starting and stopping turbine units and the method of testing boiler water.

In the line of good operation, the following procedure in cutting in a new turbine and taking off the old unit has been found quick and effective:

To Put a Steam Turbine in Operation

1. Open all drains and 2 valves on bleed lines.
2. Open steam valves slowly. Then change valves behind control board.
3. Start auxiliary oil pump.
4. Start another circulating pump and open condenser valve about 4 in.
   Crack sealing water valve to atmospheric valve.
   Crack oil cooler valve. Generator air cooler valves open wide.
   Open gland water valve in basement wide, also open air ejector cooling valve about 2 in.
5. Start turbine rolling and keep from 10 to 20 lb. pressure on primary gage. Go down and close drain valves and 2 bleed valves. Let turbine run at least 8 minutes.
6. Open float valves on condenser and all valves on one condensate pump. Start condensate pump.
7. See that all valves are O. K. on air ejector, open steam valve to bottom jet only.
8. When 5 in. vacuum shows open gland water valve to about 3 lb. pressure.
9. Change heating system now while machine is coming up to speed.
10. When 20 in. vacuum shows, steam valve to top jet of air ejector. Look at oil temperature once in a while, both machines.
11. When turbine is up to speed, put it on the line.
12. Put 500 or 600 kw. on it, then change heater valves. Then all the load on it and look it over to make sure everything is all right. Drop other machine off the line.

To Take Turbine Out of Operation

1. Trip it off. Close throttle valve. Be sure auxiliary oil pump starts.
2. Close steam valves on air ejector. Let gland water stay on until the vacuum goes down to about 10 in. Close cooling water valves, condenser first.
3. Shut off condensate pump and close all valves and float valves. By that time gland water can be shut off.
4. When machine stops, close all header valves and shut valve on auxiliary oil pump.

Pressure Regulation

Good power plant practice would keep the steam pressure at the throttle of the steam turbine constant. As surges of power occur, the pressure of the steam must vary some place. Here it is allowed to vary at the boilers which is of no consequence. But as the pressure varies at the boilers it is automatically kept constant at 400 lbs. per sq. in. at the throttle, by means of the Master control back of the boiler panel. Fig. 1 shows this control diagrammatically. As the throttle pressure tends to change, it acts upon a small diaphragm, then through a system of levers to a diaphragm on a container called an air tunnel and also to a diaphragm in a glycerine-filled container called the compensator. As pressure acts through a bleeder valve in the compensator to a line connecting the other end of the compensator to the air tunnel and also to the regulators for draft and coal, the steam pressure at the boilers is caused to compensate and thus hold the throttle pressure constant. By adjusting the diaphragm where the throttle pres-

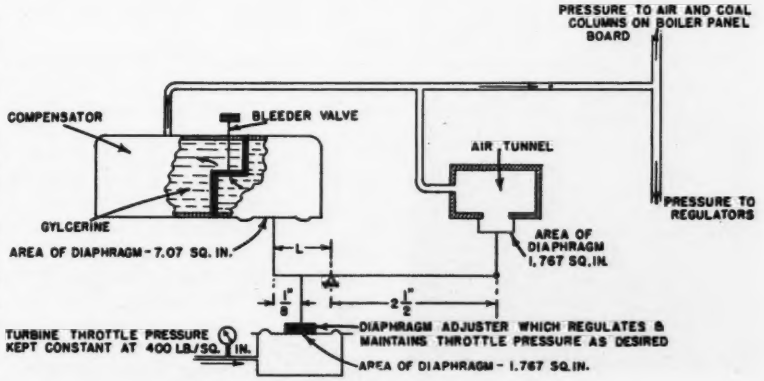

PRESSURE TO AIR AND COAL COLUMNS ON BOILER PANEL BOARD
COMPENSATOR
BLEEDER VALVE
AIR TUNNEL
PRESSURE TO REGULATORS
GYLCERINE
AREA OF DIAPHRAGM - 7.07 SQ. IN.
AREA OF DIAPHRAGM 1.767 SQ.IN.
L
1" 8
2 1/2"
TURBINE THROTTLE PRESSURE KEPT CONSTANT AT 400 LB/SQ. IN.
DIAPHRAGM ADJUSTER WHICH REGULATES & MAINTAINS THROTTLE PRESSURE AS DESIRED
AREA OF DIAPHRAGM - 1.767 SQ.IN.

Fig. 1. Diagram of the water pressure control

[1] September issue, p. 65. October issue p. 84.

sure acts, any desired throttle pressure may be maintained. Then it is through this master control that the draft regulators and coal regulators are operated.

Boiler Water Testing

Another way plant efficiency and economy are increased is through the results obtained from boiler water testing. The boiler water is continually tested, once a day, for sulphite content, sulphate content, total alkalinity sodium carbonates, and pH (Hydrogen-Ion concentration). With the results it is determined when chemicals should be added to the feedwater, when it is necessary to blow down the boiler to get rid of sediment caused by carbonates, and what else can be done to improve the quality of feedwater and boiler water.

The boiler water sample is taken from the finned cylinder on the side of the boiler which is filled with steam when the fireman blows down the water column and glass and condenses in there. A description of the different tests taken follows:

1. Sulphite: Mix in a large porcelain dish.

1 cc. hydrochloric acid (HCL).

250 cc. boiler water sample.

1 cc. starch.

Stir constantly while adding "standard Potassium Iodate Potassium Iodine solution" until contents turn to a dirty blue color. Read amount of Potassium solution used, and multiply by 5 (constant of the Potassium solution). This is the sulphite content in the water in p.p.m. (Parts per million).

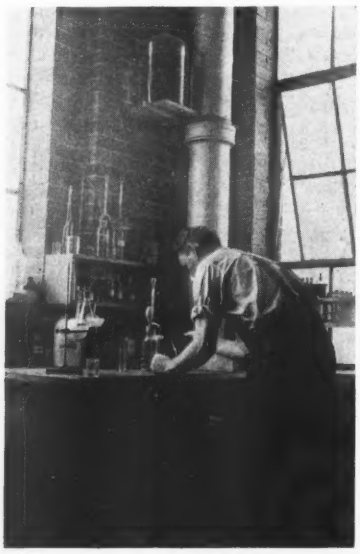


Fig. 2. Testing boiler water in the laboratory

2. Sulphate: Mix in a corked flask.

58.3 cc. (Miniature gallon) of boiler water sample.

10 cc. Bensidine Solution.

Mix with a whirling motion. When silvery particles appear, pour contents through filter paper in a funnel and catch filtrate in a beaker. Throw filtrate away if not cloudy. Add 25 cc. of distilled water. Shake until paper is broken up, add 2 drops of Phenolthalein Indicator, and add drop by drop N/7 Sodium Hydroxide, putting cork into flask and shaking each time, until a pink color remains half a minute, and disappears. Read the amount of N/7 solution used and multiply by 10 (constant of N/7). This is the sulphate content in the boiler water in g.p.g. (grains per gallon).

3. Total alkalinity Sodium Carbonate:

First: Put in a porcelain dish 58.3 cc. boiler water sample, add 3 drops of Phenolthalein indicator. A pink color is manifested. Stir constantly while adding, drop by drop, N/60 Sulphuric Acid until color disappears. Read the amount of N/60 used. Record this which is the "P" reading (Phenolthalein).

Second: Put in a porcelain dish 58.3 cc. boiler water sample, add 5 cc. Barium Chloride (130 gms. per g.) and three drops of Phenolthalein for the pink color. Stir as before while adding N/60 until color just disappears. In about a half a minute's time the color should partially return. If it does not, too much N/50 was added. Read the amount of N/50 used and record it under the reading above as "PB" reading (Phenolthalein-Barium Chloride). Subtract the second from the first and multiply by 2. Add the "PB" reading to this and multiply by 1.06 (constant of N/50). This result is "Total Alkalinity Sodium Carbonates" in the water in g.p.g.

4. PH (Hydrogen-Ion concentration in the water):

Boil away about half of 58.3 cc. of boiler water sample. When cool, add enough distilled water to make 58.3 cc. again. Using the "PH" tester, put sample in three test tubes. Fill one test tube exactly to the line, add 1 cc. of blue solution provided with tester and mix thoroughly. This sample is placed behind a sealed test tube containing distilled water. The other two samples are placed at each side of the colored sample. In front of these two are placed color test samples of different PH values. Whichever one of these or others tried resembles closer in color the colored boiler water sample gives the PH content in the boiler water.

A representative test of boiler water sample follows:

List of Principal Equipment

Boilers: Babcock & Wilcox Co., 2, integral furnace type, maximum rated capacity 45,000 lb. per hr. each at 200 per cent of rating, design pressure 250 lb. per sq. in. ga.
Burners: Babcock & Wilcox Co., two coal and two steam mechanical oil burners.
Coal Pulv.: Babcock & Wilcox Co., one per boiler.
Water Column: Reliance Gauge Column Co.
Safety Valves: Consolidated Ashcroft Hancock Co.
Blow-off Valves: Yarnall-Waring Co.
Non-return Valves: The Edward Valve & Mfg. Co., Inc.
Soot Blowers: Diamond Power Specialty Corp.
Boiler Meters: Bailey Meter Co., 2, four pen: steam flow; air flow; flue gas temp.; and coal-air temp.
Draft Gages: Bailey Meter Co., 2, six point: prim. air diff.; pulv. air diff.; sec. air pres.; furnace draft; uptake draft; spare for future induced draft.
Master Recorder: Bailey Meter Co., 1, two pen: main line pressure; feedwater temp.
Pulv. Ammeters: General Electric Co. Two.
Coal Indicators: Stephens-Adamson Mfg. Co., 2 high and 2 low.
Gauges: Consolidated Ashcroft Hancock Co.: boiler pres.; feedwater pres.; back pres. Crosby Steam Gage & Valve Co.: line pres.; air supply pres.; city water pres.; fire pump line pres.
Air Compressor: Ingersoll-Rand Co.
Comb. Control: Bailey Meter Co., full automatic.
Coal Hand. Equip.: The Jeffrey Mfg. Co.: belt feeder with magnetic pulley 35 t. per hr. cap.; perfect discharge elev. 35 per hr. cap.; Helicoid conveyor, 35 t. per hr. cap.
Coal Valves: The Stock Engineering Co. 18 in.
F. D. Fans: The Buffalo Forge Co., two 6½ S.L. 55,000 lb. per hr. at 5.4 in. water and 100 deg. F.
F. W. Heater: Cochrane Corp., 6000-10000 gal. per hr.
Cont. Blowdown: Cochrane Corp.
F. W. Regulators: Bailey Meter Co.
F. W. Pumps: The Buffalo Pump Co., 2, one motor, one turbine driven, cap. 180 g.p.m. at 212 deg. F. and 280 lb. pressure. Turbine drive, Type Z1, Terry Steam Turbine Co., motor drive 50 hp., Gen. Elec. Co.
Condensate Pumps: The Buffalo Pump Co., 2, one motor, one turbine driven, capacity 188 g.p.m. at 212 deg. F. and 75 ft. head. Turbine, 12 in. T.F., Coppus Engineering Co. Motor, 10 hp., Gen. Elec. Co.
Booster Pump: The Buffalo Pump Co., one 100 f.p.m. at 75 ft. head driven by a 5 hp. General Electric Co. motor.
Backwash Pump: Ingersoll-Rand Co., 3CRVL.
Boiler Settings: The Rust Engineering Co.
Blowoff Tank: The Buffalo Tank Corp.
Cond. Tank: The Buffalo Tank Corp.
Coal Hoppers: The Buffalo Tank Corp. 2.
Breeching: The Buffalo Tank Corp.
Chimney: The Rust Engineering Co., 7 ft., T.D. by 186 ft. high, concrete.
Fabricated Pipe: The National Valve & Mfg. Co.
Cond. Level Control: The Mason-Neilan Regulator Co.

Sulphite .....20.00 p.p.m.
Sulphate .....12.80 g.p.g.
Total alkalinity
sodium carbonates. 3.23 g.p.g.
P. H. 10.6

When the carbonates get too high, the boiler is blown down. When the sulphates get too low about 1¾ lb. Sodium Sulphate is added to the feedwater at the boiler feed pumps. Fig. 2 shows a picture of the Chemical laboratory and apparatus.

Other items mentioned briefly show other ways that the plant personnel economize and make the plant run more efficiently. The supply system in the plant is kept up-to-date. Cabinets hold repairs and supplies for every part of the plant, such as: gaskets, valves, small motors, mercury, oil, etc., so if anything needs replacing or repairing it can be taken care of immediately. Then that item is reordered and placed in the cabinet so the operators are never caught short.

Another saving brought about was the purchase of a power factor meter and 15 minute demand chart. This was a meter badly needed. The chief operator discovered it in a neighboring plant. It had never been used but had been there several years. It was old fashioned, and could be purchased at a ridiculously low price, but it serves the purpose very well.

Welding and Pressure Vessel Codes

By ANTHONY A. FETTE

Chief Engineer
Burger Brewing Co.
Cincinnati, Ohio

NOT LONG AGO we had an experience with the installation of a welded accumulator which might well be taken as an object lesson by engineers dealing with pressure vessels subject to insurance or code requirements. This accumulator, used in connection with a new brine tank, is 20 in. in diameter, code welded at the factory, inspected and approved before shipment.

During construction it was necessary to make changes in the piping arrangement and to satisfy the different contractors the main 5 in. suction line was lowered 5½ in. A new hole was burned in the shell, a suction pipe welded in and the original opening filled with a welded end disc.

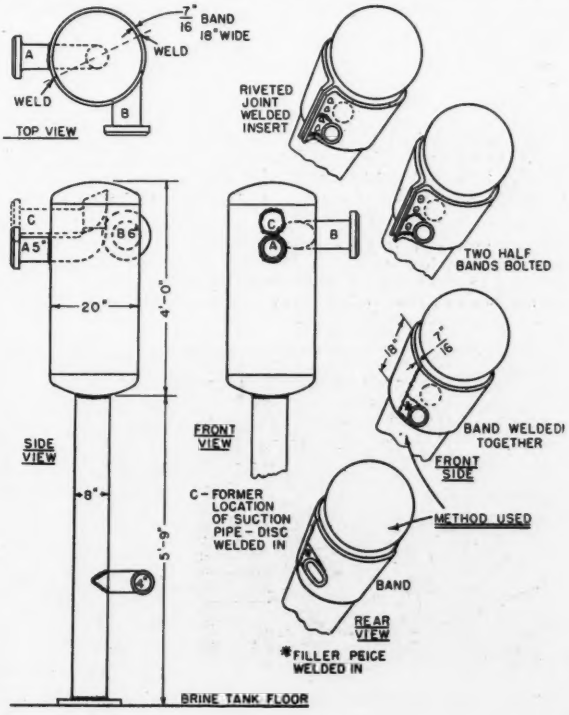
Insurance Co. Refuses to OK Installation

After the work was completed, it was tested out and the system filled with ammonia. The insurance inspector refused to pass it and reported a serious violation of the state code to the Ohio State Boiler Division. The insurance company insisted that the accumulator be removed and replaced by a new one. This would have cost $150 f.o.b. factory with no allowance for the old one and of course the $150 would have been the smallest part of the cost of tearing out the covered end of the tank, replacement of piping and removing and replacing the accumulator.

Discussion between the various interested parties went on for several weeks. It was suggested that an elliptical plate, might possibly have been approved. Again, with a patch riveted on the inside was suggested as a possible solution. The insurance company, however, insisted on replacement of the entire accumulator.

Band Around Entire Shell Solves Problem

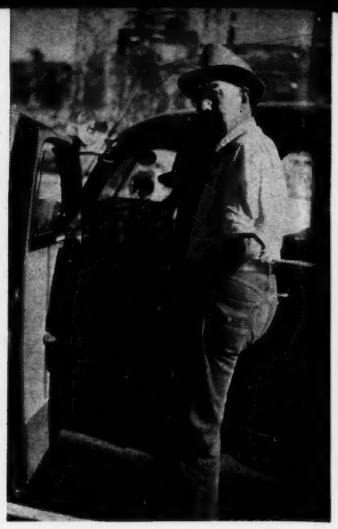
After this I proposed to weld a new $\frac{7}{16}$ in. thick band, 18 in. wide, onto the outside of the accumulator, over the patch and around the original suction pipe opening. After a great deal of correspondence and considerable traveling and discussion, this method was approved by all parties. The band was made and welded on at a total cost of $12.70. We continued to operate the new brine tank during this controversy which extended from June 11 to February 15 of the next year, or slightly over 8 mo.



Details of accumulator arrangement and method of reinforcing used to meet insurance and code requirement after suction C was lowered 5 in. to A to accommodate piping changes. Three repair methods shown were suggested the one marked was used

Left to Right. Charles W. Ragan, Construction Superintendent. Clayton M. Allen, Assistant General Construction Superintendent. William F. Fehring, Construction Superintendent. All of Los Angeles Bureau of Power and Light

James F. Moran, General Construction Superintendent, Los Angeles Bureau of Power and Light



R. R. Robertson, Engineer of Construction, Los Angeles Bureau of Power and Light. In direct charge of construction

Building The World's Highest Voltage Transmission Lines

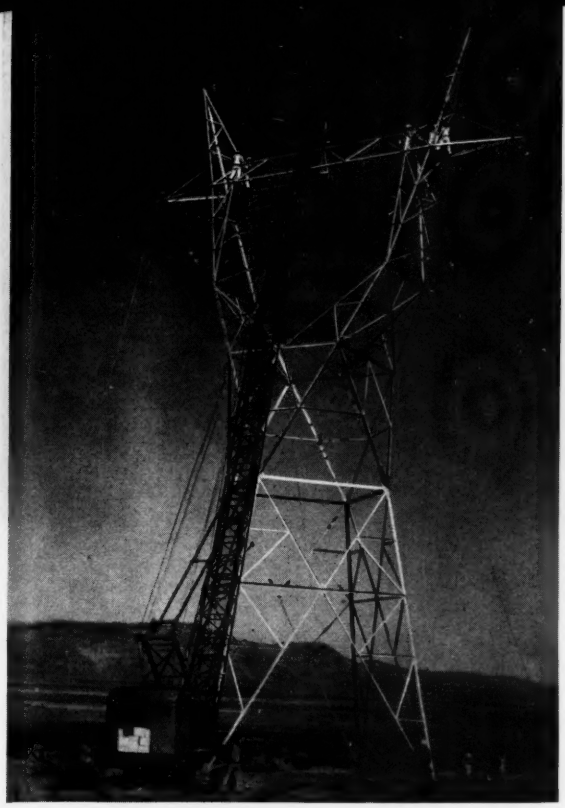
THE CONSTRUCTION of the Boulder Dam-Los Angeles transmission lines mark a new high in transmission line practice, for these lines are not only the highest voltage transmission lines in the world, and the longest, but also the most unusual in every element of their design and construction. These pictures, showing the construction of the third 287,500 v. steel tower line, provide some idea of the magnitude of the job. The line consists of 1426 towers with a total weight of 16,300 tons and 3210 tons of HH hollow copper conductor erected over the desert and mountains of Nevada and California. The towers were erected by several methods. The conventional method of a floating gin pole was used on special towers and on all towers in rough country but the standard 90 and 100 ft. towers, the latter measuring 120 ft. from the ground to tip of ground wire, were erected by a long boom crawler crane. These cranes have been used for many purposes but it remained for the Los Angeles Bureau of Power and Light to pioneer the complete erection of level country towers by means of this type of crane. The (P-H) 105 ft. boom, gasoline driven crawler crane (80 ft. plus 25 ft. jib boom) with operator, strawboss, a crew of 6 high men and 6 ground men would erect 3 standard towers in one shift.

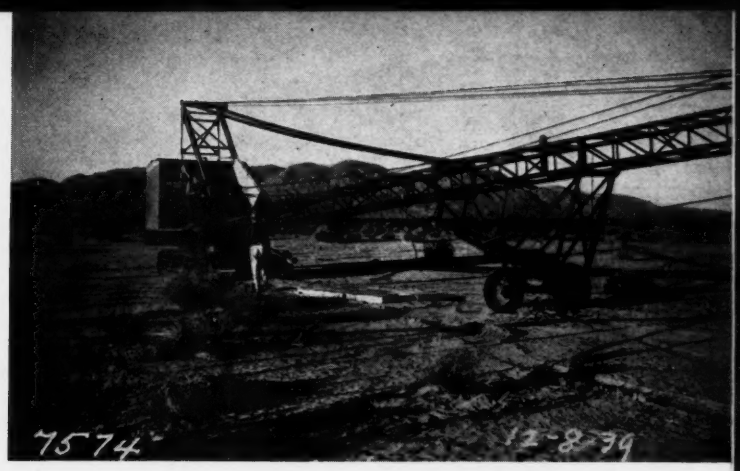
The structural aspects of these transmission lines are amazing enough in themselves but equally important were the purely electrical problems which had to be solved. The development of the 1.4 in. diameter hollow copper segmental conductor for example involved a research and development program of major proportions. The selection of this size conductor was necessary to avoid corona losses which would have been introduced had smaller diameter conductors been used. The development of this conductor required the development of special machinery for manufacturing and special tools and technique for effecting splices.

This third circuit was completed on May 1, 1940, and was placed in service the next day. The line is 259 miles long and was completed in the record time of ten months, under the direction of R. R. Robertson, Engineer of Construction; James F. Moran, General Construction Superintendent and Clayton Allen, Assistant General Construction Superintendent, all of the Los Angeles Bureau of Power and Light. For the photographs and data contained on these four pages we are indebted to Clayton Allen.

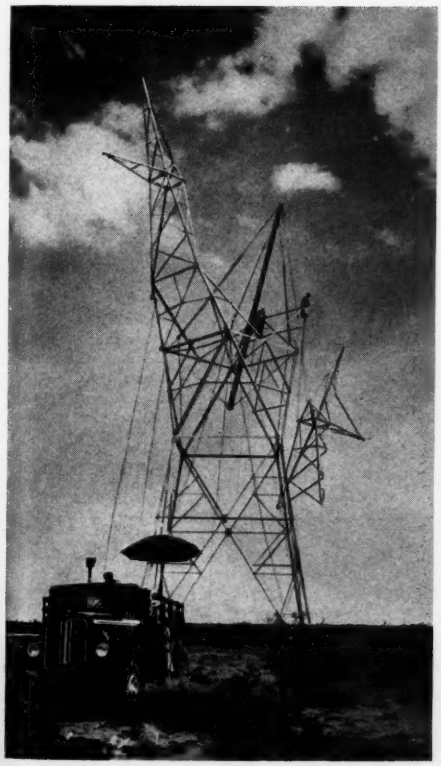
Schools of instruction were held for foremen and strawbosses before starting stringing operations to give reasons for some of the special instructions issued and to familiarize the leaders with the proper tools and methods. W. S. Peterson, Transmission System Engineer, conducted these schools

Starting operations. Truck mounted derrick assists ground crew with the assembly of tower parts ahead of the crane erection crew. The towers were mounted on concrete footings. Removable metal concrete forms were used in these concreting operations

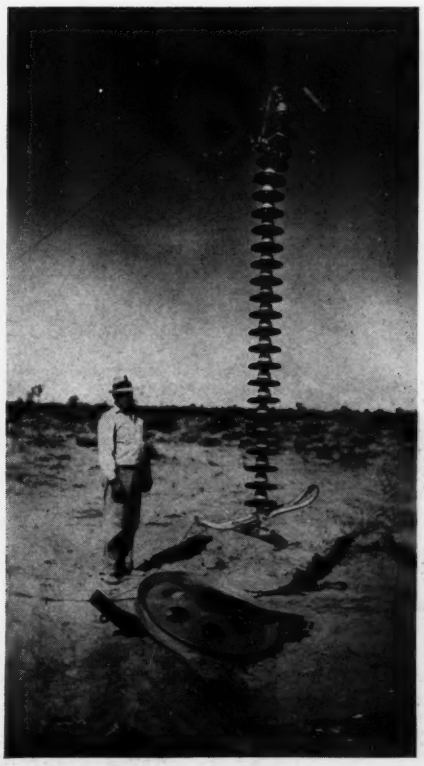


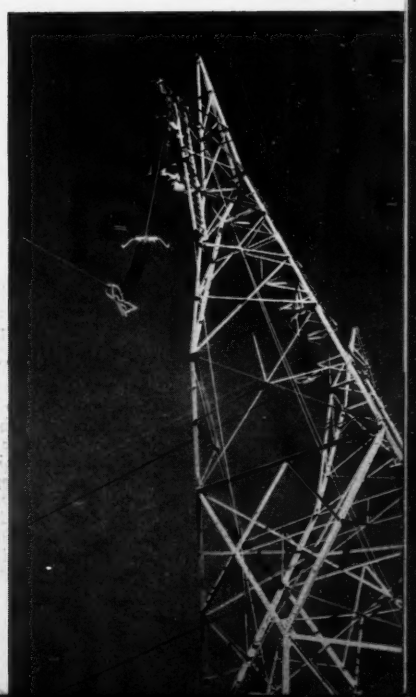


Left. The long boom crawler crane in action. These cranes have been used for many purposes but it remained for the Los Angeles Bureau of Power and Light to pioneer complete erection of level country towers with them. With operator, strawboss, a crew of 6 high men and 6 ground men, and this 105 ft. boom crane, 3 standard 100 ft. towers could be erected in a trifle over one shift. Eleven separate lifts were made on the 90 ft. towers and 13 on the 100 ft. towers, the members having previously been assembled and bolted up on the ground by layout and boltup crews using the specially adapted truck mounted derrick shown below on the adjacent page. Above is shown a specially constructed rubber tired dolly used in moving the crane between tower sites

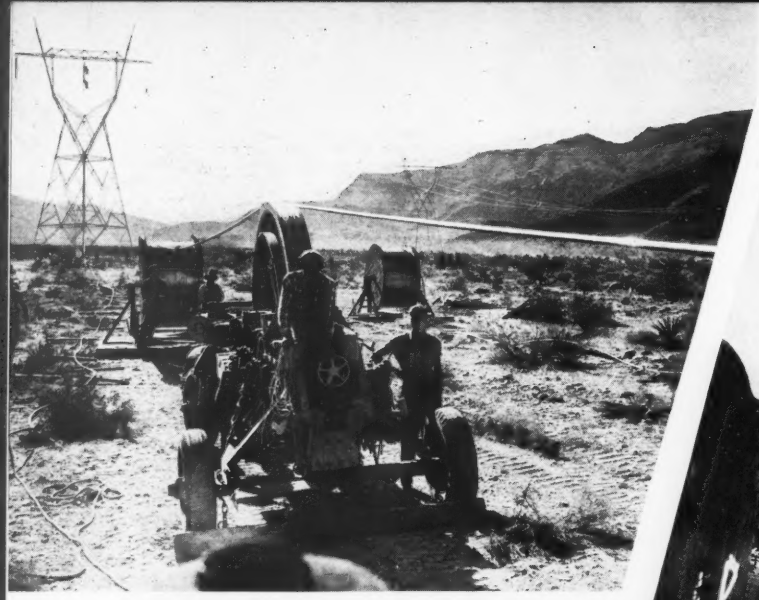


Below. Suspension insulator assemblies were made up on the ground and hoisted into place by truck mounted gasoline driven hoists. The 36 in. roller bearing aluminum stringing sheaves were hung from cross arms by chains which contained a plate for attaching a ratchet hoist and transfer yoke for lifting the conductor during this clipping in operation. The clipping in crew is shown in a picture on the following page. Below, the view at the left gives a good idea of the size of the suspension insulators. At the right, the string of insulators is being pulled up. A truck mounted or tractor mounted winch supplies the power through a ½ in. wire rope. The suspension insulator assemblies consist of 24 standard 10 in. insulators with upper and lower arcing horns and bird guard

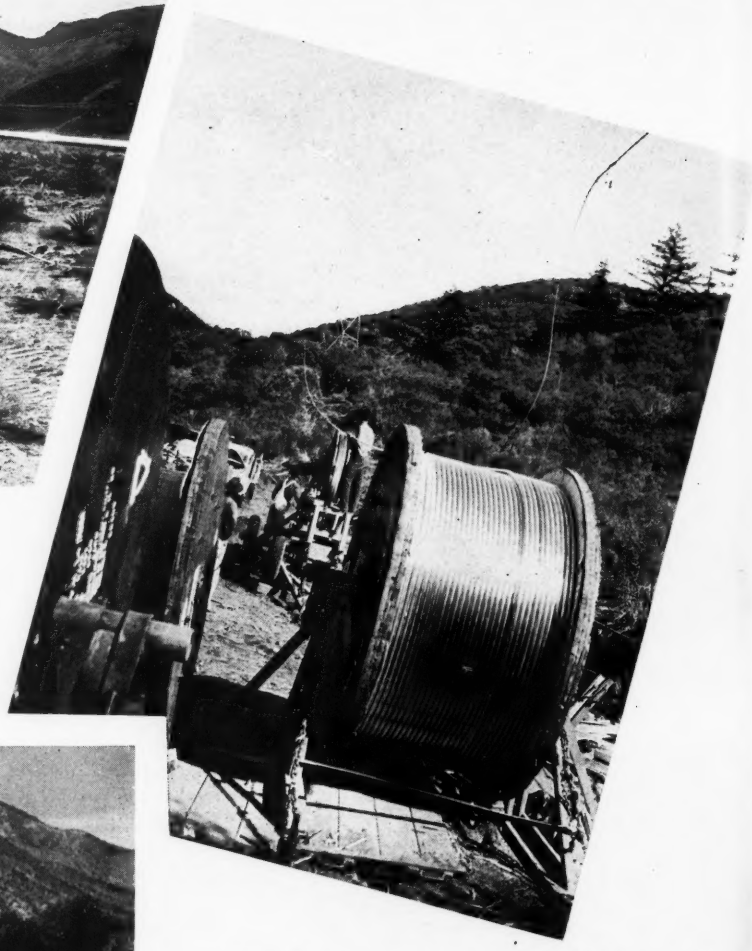




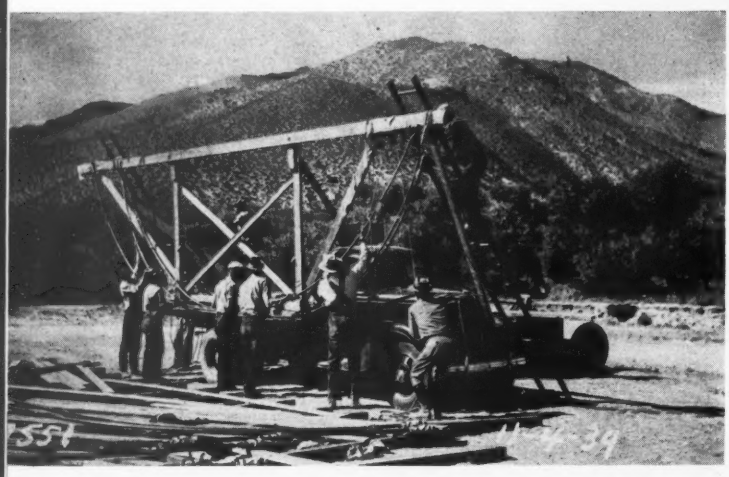
Above. Towers were erected by several methods. On level ground the long boom crane shown above was used. On special towers and on all towers in rough country the conventional method using a floating gin pole was used. This is illustrated above. Electrically welded telescopic steel gin poles, 27 ft. long and extending to 50 ft. were designed and used by the Bureau's forces. Sixteen crews were equipped with these poles



Above. The hollow copper cable is strung out from the mile-length reels over a "bull" wheel or tension machine by which absolute control of the conductor is maintained during stringing operations. The conductor is never allowed to drag on the ground while being pulled in and perfect control is maintained by a telephone communication system between the winch operator, "bull" wheel operator, sagger and strawboss

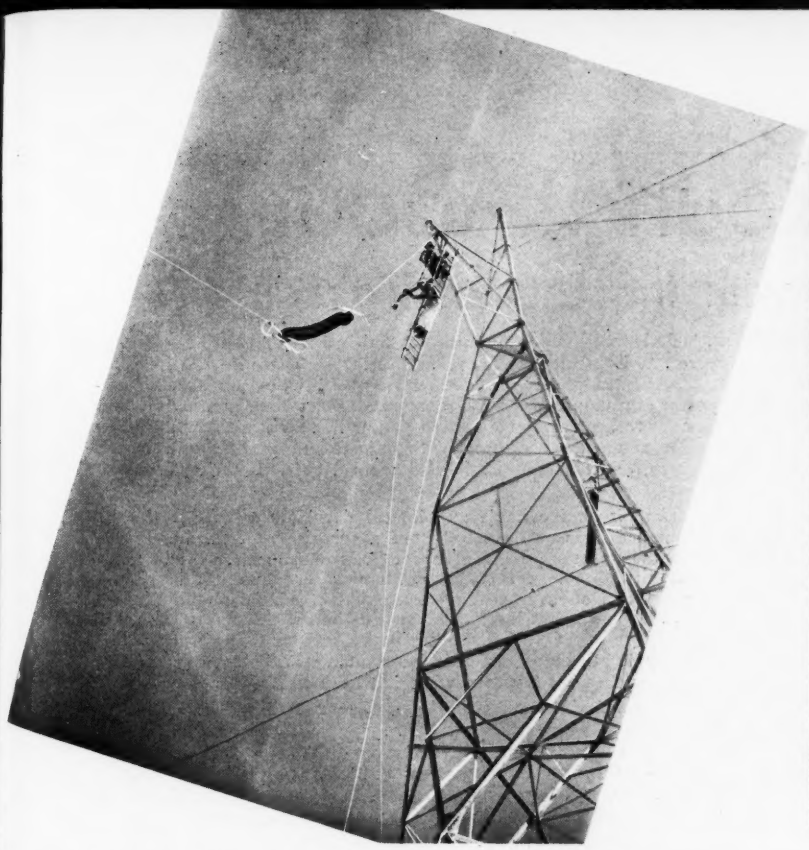


Above. One of the mile-length reels of hollow copper cable. Note the end of the previous mile-length of conductor which is "snubbed off" ready to be spliced onto the end of the length being pulled in



Left. Jumper loops for dead end towers were fabricated at construction camps. ¾ in. I.P.S. copper tubing was inserted inside the hollow type HH conductor and bent to proper shape for each tower according to the horizontal and vertical angles for the particular location. Due to short turns on mountain roads, jumper loops were mounted in a vertical position on a special truck frame for transportation to the tower

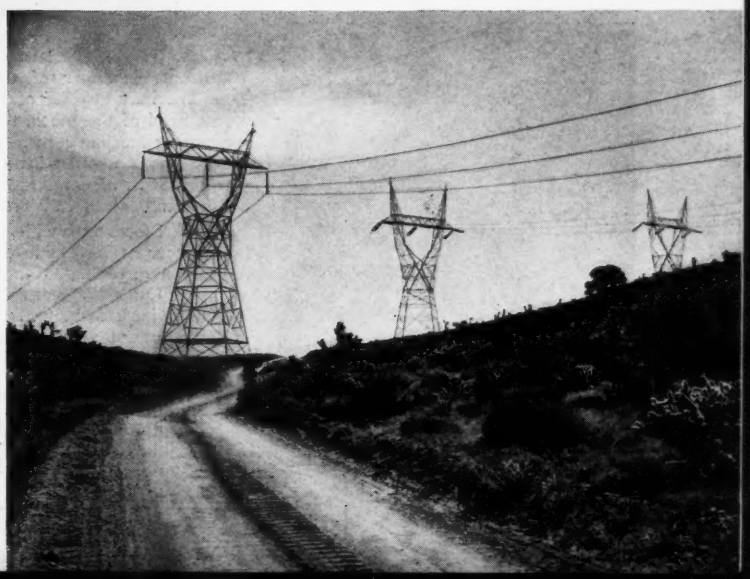
Right. The Hemstitcher in action. Two ¼ in. black copper counterpoise rods were buried to a depth of 36 in. by this plow, called a "Hemstitcher" by its crew. This counterpoise is part of the lightning protective system and is attached to tower legs by a spark gap, the purpose of which is to prevent circulating currents and consequent electrolytic corrosion. In addition to providing the insulation necessary to break the circuit, the counterpoise gaps serve to indicate the location of lightning strokes. The first indication of outstanding importance from these gaps was observed on one of the earlier circuits in the case of a direct hit involving 7 towers. From the nature of the burns a code was developed providing valuable data regarding lightning strokes



Above, left. The "clipping-in" crew transferring one of the outside conductors from the 36 in. aluminum roller-bearing stringing sheave to the final insulator assembly. Tools and equipment used in making this transfer consist of a ratchet hoist, a transfer yoke, a 20 ft. skyhook ladder and a small truck mounted gasoline driven hoist

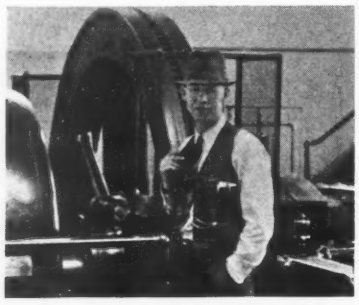
Above, right. Workmen were encouraged to take salt tablets to build up their resistance to heat exhaustion

Above. Splicing the special hollow copper transmission line conductor. A light weight, easily operated hydraulic press applies a 10,000 lb. pressure to conductor splices, insuring proper seating of parts—which is well above the maximum designed stress of 8700 lb.

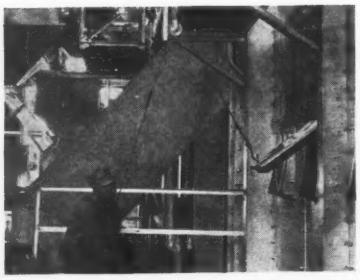


Right. Completed and ready to go. On May 1, 1940, the third, 287,500 v. Boulder Dam transmission line of the Los Angeles Bureau of Power and Light was completed. The line was placed in operation the following day. Note the lightning recorders on top of the ground wire peaks of the towers of the first two circuits on the left. These recorders are installed on towers where lightning is most likely to occur

R. R. Long *on watch at the East Peoria Station of the Central Illinois Light Co., Peoria, Ill. A punster might well say, "It's the life of Riley."*



B. H. Whitehouse *doesn't talk much but keeps a close watch and misses very little around his plant at the Milwaukee County House of Correction.*



S. B. Scammon, *boiler room foreman, Riverside Station, United Power Mfg. Co., Davenport, Ia., takes a look at the fire through one of the explosion doors opposite the superheater.*

Ed. Doerfer *polishes up the log at the University of Wisconsin power plant.*

'Round About

with the Engineering Editor

AT PROVO, UTAH, the municipal plant was finished late in April . . . June averages were . . . Equivalent evaporation 9.70 lb. . . . coal rate 1.47 lb. per kw-hr. net . . . 17,600 B.t.u. per kw-hr. . . . coal cost 2.25 mills per kw-hr. net . . . Auxiliary power consumption 4 per cent of total generation, unusually low due to variable stroke reciprocating boiler feed pumps . . . **R. C. Adams,** Superintendent of the Department, was formerly Superintendent at Fremont, Neb. . . . **Roy W. Brown,** Chief Engineer, is also from Nebraska—Schuyler and Hastings.

Mechanized warfare is an inevitable and logical development of the times but mechanized romance comes as somewhat of a surprise . . . Somehow or other a chugging Diesel tractor pulling a hayrack full of rollicking youngsters seems like a mixed metaphor . . . Incongruous to everyone except the happy youngsters to whom Old Dobbin is nothing more than a symbol of the Horse and Buggy Days. . . . Fluorescent lights are used in the dark room at Battelle Memorial Institute, Columbus, O. . . . The illumination is much better than with the conventional ruby light, almost as good as ordinary artificial illumination but the sensitized paper does not fog even when left open and exposed.

The Mormon Tabernacle in Salt Lake City was completed in 1867 and has held a counted audience of as much as 11,250 . . . The roof or ceiling is a half elipsoid, 150 ft. wide and 250 ft. long, held together with wooden pegs . . . It is now wired for electricity through holes in the ceiling provided by Brigham Young when he designed it 75 yr. ago.

As usual the California delegation was much in evidence at the recent N. A. P. E. Columbus Convention . . . of the 58 conventions the West Coast has had but one, Los Angeles in 1926 . . . San Francisco has high hopes of landing the 1942 convention . . . Overheard at the Convention . . . "The engineer who is afraid to share his knowledge and exchange experiences is on the way out." . . . A pretty good proverb to stick on the front page of your notebook as a precaution against ossification from the neck up.

N. D. Weaver, production manager of the Capital City Products Co., Columbus, O., recently installed a new flyash collector in the stack and feels that it will correct a nuisance of several years' standing . . . **David R. Black** is chief engineer . . . About one dump truck full of flyash is removed every 4 da. . . . To make the installation, fires were pulled 9 P. M. Friday but the stack was not cool enough to work on until 3 A. M. Saturday . . . The boilers were in service again 8:30 A. M. Tuesday . . . This was the first time since the 1913 flood that the fires were all out . . . A similar installation on underfeed stokers at the Seaman's Body plant, Milwaukee, is said to remove dust equal to 3 per cent of the weight of the coal fired . . . In another installation to reduce the dust loading from 500 to 75 gr. per 1000 cu. ft. . . . About 25 per cent of the collected material runs minus 325 mesh.

Men at work is an inane title but the typesetters were all out of rubber type . . . we had to abandon the snappy but long 4P. title Photo Phans Physiognomy Phraternity . . . Notice the pulley and hook arrangement used at Riverside to give a straight pull on the inclined door . . . The observer is far enough away to prevent singed eyebrows from possible puffs . . . **B. H. Whitehouse** who recently developed into one of our prize authors has hardly opened his bag of tricks yet . . . **Vernon M. Huff** who has a swell series of practical lubrication articles coming up is now in Uncle Sam's Ordnance Dept. oiling the wheels of National Defense.

J. A. Drogue is plant engineer at R. C. A.'s Indianapolis plant . . . **O. H. Pfersdoorf** is super of the CIPSCO's new Hutsonville (Ill.) Station . . . **Tom Sherman** is chief of Knudsen's Creamery in Los Angeles . . . **A. W. Tondreau,** head of the mech. dept. Warner Bros. Studio is the man who must know everything mechanical . . . Across the way at Walt Disney's new studio Mickey Mouse has a new bathtub full of gadgets for sound effects . . . Soapy water works best . . . On animated shorts it takes four men about six weeks to do the backgrounds alone . . . These average about 44 per picture.

T. F. Steenrod is chief engineer at the East Peoria Station . . . **Will Weise** is engineer at Riverside Station . . . **Rex Sayre,** who drew the two-fuel CO_2 charts on page 82, October, is there also . . . **Paul Beexton** is chief at the Western Cartridge plant at Alton, Ill. . . . and **Harry Atchley** at the Crystal Tissue, Middletown, O. . . . Windsor Station, 99.9 per cent of Power, W. Va., is again in the news because W. Penn is topping its half of the station . . . **J. E. Guy** is super and **E. M. Plumber** assistant super.

Richard H. Morris

The PRACTICAL ENGINEER and ELECTRICIAN

RALPH E. TURNER, EDITOR

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THE LOWLY 6-FT. RULE

You would not use a micrometer caliper to measure the diameter of a wooden telegraph pole you are turning down for use on the streets. Neither would I. But I have many times found myself carrying mathematical calculations out to the fourth decimal place when I am sure the original data was not correct beyond the first decimal place. This is not being accurate but just an illusion of accuracy. Such traits of mind are habits that grow upon people as a result of the requirements of their work and as one shifts from one task to another he must adjust his degree of accuracy to the requirements of safety, of economy and then of appearance. What many of us overlook in our extreme care to be accurate is the time it takes and this time can easily run into an inexcusable economic loss.

Nearly everybody is aware of the convenience of the folding 6-ft. rule for measuring the distance between points. We do not expect it to be absolutely accurate but it is accurate enough for many purposes and for such uses will save time. Few of us, however, have taken the trouble to extend the use of this lowly tool to the measurement of triangles and circles as explained by E. G. Key and F. E. Saari on another page of this ssue. In this instrument, if we may be allowed to dignify it by such a term, we may find a rival to the carpenter's square or the slide rule in the extent of its uses. R. E. T.

A Section of Power Plant Engineering Devoted to
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Engineers And Their Work

All important to the power industry is the approach of the young men to the engineering profession, the mental attitude the engineer maintains toward his work and his sources of usable information. These human problems are engaging the thinking of many engineers and the articles presented here are chosen from many that have recently been received.—Editor.

Opportunity for the Young Man in Engineering

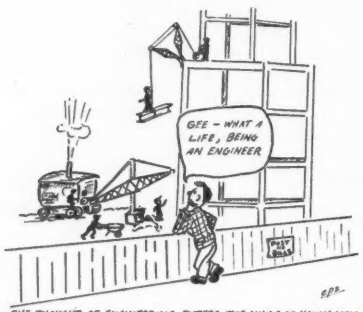
By A. G. Solomon

YOUNG men who are just starting out in life are very often guided in their choice of profession or trade by their surroundings and by the things they see in their daily wanderings.

There is no city in the entire country that has so much of the engineering and mechanical atmosphere as is found in Washington, D. C. During the past 10 yr. no person could drive or walk for a half hour's time without coming in contact with or seeing some feat of engineering being performed. Massive buildings were being erected on property from which other buildings had been torn down and removed. Excavation on a large scale was being done to provide basements and subbasements as well as for foundations. Long piles were being driven down to rock. Tunnels and underpasses, bridges and viaducts were under construction all over the city and in nearby Virginia and Maryland.

With all this engineering activity in plain view on every side is it any wonder that the thought of engineering and other mechanical trades should enter the minds of the young men who are just finishing school or college or of those who have been away from school a year or more?

The great majority of these young men must find work of some kind so that they can take care of themselves or help out with the family needs. They are, as a rule, an energetic and healthy gang and are anxious to be on their way up some ladder at the top of which they hope to realize their dream of success. There must be a great number of these young men who would rather follow engineering or some mechanical trade than any other profession or business.



THE THOUGHT OF ENGINEERING ENTERS THE MINDS OF YOUNG MEN

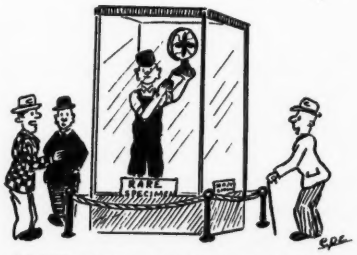
After leaving school these young job hunters will try to land something to their liking. Engine rooms, machine and boiler shops, pipe shops, refrigeration service shops, and such shops as install and service different mechanical equipment will be visited and applications will be filed. The young applicant will feel hopeful and almost sure of some kind of a mechanical job in a short time. Time passes. The need of work will soon force the young man to finally take a job of any kind. And in 9 cases out of 10 the desire for engineering will pass out of the young man's mind, never to return. He will stick to what he gets and be thankful that he has a job and is able to earn some money.

The opportunities for advancement, good wages and an almost assured future are very good in all the branches of the engineering field. Year round air conditioning is the youngest member of the engineering family. Artificial ice skating rinks are becoming popular but they will be few in number and require few men for their operation. Air conditioning is greatly different from what was considered as real engineering a few years ago when engineers were classed as electrical, steam, refrigerating, ice making, heating and ventilating and many other kinds. Now, a man who claims to be an experienced air conditioning engineer must be able to operate and maintain almost all types of equipment. Under his direct supervision are boilers and their auxiliaries for steam heating; compressors that handle the refrigerant for cooling and the condensers, evaporators, pumps and much other equipment.

Most of the compressors, pumps and fans are motor driven so the engineer must also be able to handle the electrical end of the plant. He must also understand humidity control for both summer and winter. The treatment of water and the circulation of air are also part of his regular duties. Automatic controls of all kinds and types are found in all plants for the control of temperatures, pressures, humidity, fan speeds and a great many other conditions.

This shows that the young man who wants to start in the engineering game has to go through many years of actual practical experience and much hard study before he passes up just a few rungs on the latter of success. But there is room at the top. At the start of the career there is much over-crowding and many are pushed out before they really begin. Then, as progress goes on, others are forced to quit or are anxious to quit as the pace is hard and seemingly slow. When the top is reached there are very few left of those who started.

A first class engineer for an air conditioning plant is hard to find and his services are in constant demand.



A FIRST CLASS ENGINEER FOR AN AIR CONDITIONING PLANT IS HARD TO FIND

A knowledge of piping work is necessary in all engineering and mechanical trades. So the young man who gets a chance to work in a steam fitting or plumbing shop may consider himself fortunate. Next to pipe shops, I believe that helper to a maintenance man is best for a beginner. Installation of boilers, furnaces, oil burners, stokers, motors, heating and cooling systems all offer a good starting point. Watch places where mechanical equipment is being delivered. I knew a man who went to the shipping department of a big supply company and got a list of addresses at which pipe, fittings, hot water heaters, small boilers and other such material were to be delivered during the week. He followed up and landed a job. That is one way to find out where work is being done.

After the young man has secured a job where he will have a chance at practical experience, real study is the next step. Books on all engineering and mechanical subjects can be bought at most first class book stores and the cost is not great. The public library is a good place to visit. The technical magazines are a great help to the young as well as old engineers. If the advertising pages of these magazines are looked over carefully it will be seen that descriptive literature can be had for the asking. And such literature describes mechanical equipment of all kinds.

Catalogs and bulletins from the manufacturers will be found to contain valuable information and give an engineer many facts that can be gained

in no other way. There are opportunities in the engineering field for the young men. But the older engineers must help. Give the young man a job if possible or tell him where to go and whom to see at other plants. Do not discourage him in any way.

Perhaps the young man who comes to you tomorrow looking for a job may have the material in his makeup to become a great engineer in some branch.

Service Instructions

By Donald Osterhoudt

WHENEVER new equipment is installed in a plant and the guarantee period has passed, all necessary repairs and adjustments are, in most cases, turned over to the men who are in charge of these operations in the individual plants. These men should have a thorough working knowledge of the equipment that they have to service and should not have to go at it in a hit or miss fashion. From what little experience I have had, I find that practically all the literature that is sent out with new equipment is of a descriptive nature with, in some cases, a repair parts catalogue which is of little or no value when it comes time to make necessary repairs or adjustments. While all manufacturing companies of industrial equipment have service men whom they will send out to make these repairs, plant managers dislike to call on them because of the added delay and extra expense. I have noticed in several cases, where a certain piece of equipment has worked satisfactorily for several years until some part wore out and had to be replaced, after being repaired by the plant repair man it could not be made to work as well as it did before. Possibly because the repair man did not know how to make the necessary fine adjustments after replacing the worn parts, which eventually led to the equipment being condemned.

Every year manufacturers of industrial equipment are spending thousands of dollars for research work to incorporate in their products new and improved ideas to insure long life, economical operation and positive control, yet they seem to forget that in the long run all this depends on the ability and skill of the operators, maintenance and repair men in the various plants that have installed their equipment. If these companies would put aside some of this money and set up a department which would keep in contact with the men who actually operate and maintain their equipment after it is installed, they would be taking a big step toward their goal of long life, economical operation and positive control plus satisfied customers.

This department could be worked in with their present service and advertising departments. Service men could be sent out in the field to make personal contact with the operator and maintenance men in the various plants and talk things over with them; find out if they are having trouble with anything and if possible help them straighten it out. They could also pass along to them any helpful hints that they have picked up in their travels from plant to plant. These contact men could also encourage these men to send in any ideas that they may have for improvements on the equipment that they use. Because, after all, who knows the good and bad features of any equipment any better than the men who have to operate and maintain it every day.

Approaching Forty

By Sam Williams

IT IS with a great deal of trepidation and conjecture that we approach the crucial age of forty. It becomes a matter of self-interest that we concern ourselves with the reasons why industry has stamped "Verboten" upon its gates to men of forty and over. Are the past 10 yr. of depression, caused in part by industry, to be arbitrarily extracted from a man's life (his best years?) and the man himself relegated to the scrap heap? Pitkin claims that "Life Begins at Forty." Is being detailed to sweeping floors, washing windows, other janitorial labors, the WPA, the beginning of life? And also the end?

To come upon the cause of the phenomenon of a man experienced and willing, not being wanted, we must look to the character of the man himself. It is not without wonder, that we find that men of middle age, instead of being mellowed with the passing years, are a flinty, grumpy lot, almost impossible to get along with, grouchy and sometimes appearing not to give a damn about their work, or anything else. It is no wonder that an employer hesitates to place such a character in his personnel.

While youth has a universal characteristic, knowing it all, we know that it is caused by ignorance, but did you

Being Gentle With the Giant

Out in the west power house of the Grand Coulee Dam, workmen are shown here gently lowering the forty-ton rotor into the armature of a 10,000-kw. station service unit. Two of these units are required to fill the damsite power needs for this power plant where eighteen 105,000-kw. main generating units will be installed, the work soon to be started. Even though this is a big heavy machine, the electrical insulation on its windings need to be protected from the slightest injury for a hidden ground or shortcircuit in one of these machines is extremely expensive to repair. These men are taking no chances.

ever try to convince an older man that *his* way was not the only way? Why, in the light of years of experience, we should know that there are many ways to reach an objective.

Because of advancements in manufacturing facilities, a man of forty is just as fit physically to hold his position as a younger man. It is the older man's mental attitude, his set and unchangeable ways, his lack of adaptability that bars him to employment.

Have we not often said "If I knew at twenty what I know now?" Well, we know a lot more now than we did at twenty, so suppose we just apply ourselves to learning *more*, just as hard as we did at twenty, and remember that our family troubles, our financial worries, are not caused by our fellow workmen, so why take it out on them? Try to be more coöperative with our fellows and superiors. We can do it. Let's prove that we can change. Do we need to walk because pappy did? Let's fly!

FOR THE PLANT ELECTRICIAN

Measuring Conduit Bends

By Eugene George Key and Frank E. Saari

IN MEASURING conduit bends in out-of-the-way places or at some distance from the place where the conduit can be bent, the construction electrician will find his six-foot folding rule a very useful instrument. Some electricians have devised many ways of measuring these bends, even making trial bends in a discarded pipe and fitting that in place, using this pipe later as a model in bending the actual conduit. That method increases the labor of the job and results in needless waste of time and energy. The six-foot rule is an easy method and is so simple that anyone can quickly learn to apply it.

There are six ways to use the rule, covering all applications for bending conduit. These six ways involve measurements of:

1. Right (or 90-degree) angles.
2. Angles greater or less than 90-degrees.
3. Small bends on open ceilings.
4. Offset bends.
5. Saddle or double-offset bends.
6. Wide bends around curved objects.

The method becomes immediately simpler if all of the applications from numbers 2 to 6 are considered as special cases of number 1.

1. MEASUREMENT OF RIGHT ANGLES

As any electrician knows, a right angle bend can be made easily and checked by sight. For this reason, then, he should be absolutely sure that he has a right angle corner for his right angle bend before he tries to fit the bent conduit in that corner. Being thus sure, he need test his bend only once instead of making several false tries, perhaps to discover the corner is not a right angle after all.

All 6-ft. folding rules have 12 sections, hinged at 11 places. If all 12 sections are opened, and a triangle formed with sides containing, respectively, 3, 4, and 5 sections, the angle between the shorter legs is always a right angle. This fact can be checked by the rule of the square on the side of the hypotenuse which is equal to the sum of the squares on the other two sides. Thus:

$$3^2 + 4^2 = 5^2$$

or:

$$9 + 16 = 25$$

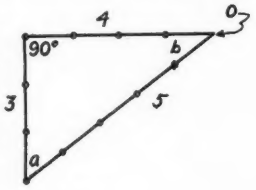


Fig. 1

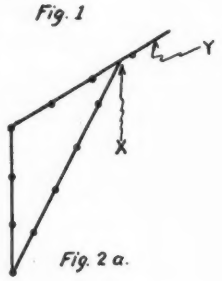


Fig. 2a.

Fig. 2b

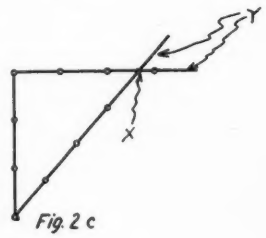


Fig. 2c

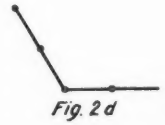


Fig. 2d

Because of the size of the triangle thus formed, it cannot always be used at the top of a ladder or in crowded places. Wherever possible, therefore, the triangle should be laid on the floor and a chalk line drawn along the edges of the rule. This chalk line can then be used as a guide.

With the chalk-line guide drawn, any angle suspected of being a right angle can be checked very easily. The electrician can climb his ladder and, using only two or three sections of his rule, measure the corner where the bent conduit is to be placed. The rule can then be placed on the chalk-line guide and checked.

Figure 1 shows a schematic drawing of the rule as it is used for making the chalk-line guide. The heavy line represents the rule and the round dots, the hinges between each section. The figures 3, 4, and 5 indicate the number of sections of the rule in each leg of the triangle, and the letter 0 the free ends of the rule. The angles *a* and *b* are, respec-

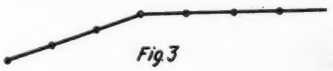


Fig. 3

Fig. 4a

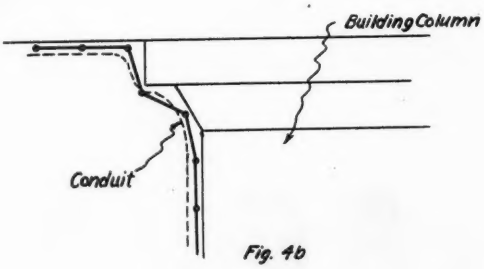


Fig. 4b

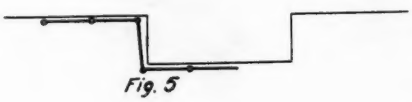


Fig. 5

Fig. 6

Use of 6-ft. rule for measuring conduit bends

tively, 53 deg. 8 min. and 36 deg. 52 min. for this particular triangle.

2. Measurement of Angles Greater or Less than 90 Deg.

Measurements of angles greater or less than 90 deg. can be done in two ways. If the angle required is in an open part of the ceiling, floor, or wall, the electrician can form his 3-4-5 right triangle as in part 1 and vary the size of the large angle. The open ends of the rule can be slipped along the sides of the triangle and pinched by the fingers at the place where two parts of the rule cross, as at X in Fig. 2a for an angle greater than 90 deg. or at X in Fig. 2b for an angle less than 90 deg. These figures (and Fig. 2c) indicate three ways of disposing of the excess sections of the rule, as at Y in all three figures.

Another way to measure these angles is to use only a small part of the rule, measuring the angle without use of the third side of the triangle. For this method, a stiff-joint rule should be used so that the angle of the rule will not change while the electrician is carrying it. Fig. 2d illustrates this method. In Fig. 2d, all sections of the rule not shown are folded out of the way.

3. Measurement of Small Bends on Open Ceilings

Occasionally, small bends must be made, and for neat work, they should be made very accurately. To measure these bends, the rule may be stretched to its full length or less, as desired. It is recommended, however, that not less than 4 sections be used, preferably more, and the rule be stiff-jointed so that it will maintain the required angle long enough for the electrician to make the bend. Figure 3 shows how to measure the small angles with 7 sections of the rule.

4. Measurement of Offset Bends

Offset bends are necessary whenever the conduit is run along the surfaces of walls or ceilings, as in some factories or shops, and may be useful in some concealed work. In Fig. 4a is shown 7 sections of the rule used to measure an offset from one ceiling height to another. Figure 4b shows how the rule can be used to measure a series of bends with an offset from the ceiling to follow a column down toward the floor. To measure these bends, a stiff-jointed rule must be used. The dotted lines in Figs. 4a and 4b indicate the possible shape of the conduit when bent to fit the installation.

5. Measurement of Saddle or Double-Offset Bends

The saddle bend is sometimes merely a double-offset bend in which both offsets are the same size, i.e., symmetrical. In Fig. 5 is shown a symmetrical saddle. The simplest way to measure such a bend is to measure one side of the saddle and use this measure for the other side of the saddle. Where the saddle is short on one side, the best method is to measure the bend as two separate offset bends. A stiff-jointed rule must be used.

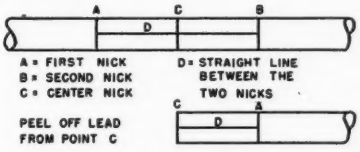
6. Measurement of Wide Bends Around Curved Objects

The principal application of this bend is to go around circular columns in surface conduit installations. The rule should be used so that each section is a tangent to the column as shown in Fig. 6. If this cannot be done, it can at least be approximated. A stiff-jointed rule must be used.

Cutting Lead Covered Cables

By W. E. Warner

Preparing lead sheathed cable without damaging either the insulation or conductors is sometimes difficult. The best way to do this is to mark off the length of the lead sheathing to be removed, then cut a nick round the cable at this point not quite through the bad sheath. If the lead sheathing has to be removed from only part of a lead sheathed cable, cut two of the nicks in between which the bad cable has to be removed.



Cable scored for removing sheathing

Then lay the cable flat and, by means of a sharp pen knife, cut a straight line between the two nicks or from the nick to the cable end. This cut should not go quite through the lead sheath. In the case of a continuous length of cable cut a third nick in the cable half way between the two first named nicks right through the lead sheathing. Then at this center nick raise up the sheathing with a pen knife, grip it with a pair of pliers and it will be found possible to easily peel the bead off and it will stop short where the first and second nicks are made.

By this means the lead can be removed without damage to the insulation or conductors except possibly at the point C. where the lead is cut right through.

Snow Surveys

Each winter on snowshoes and skis 150 men of the California Coöperative Snow Survey travel thousands of miles measuring the snow pack in the Sierras. The snow surveyors' measuring equipment weighs 17 lb. and includes a 20-ft. sectionalized aluminum coring rod and a small scales. The measurement is made by first thrusting the rod vertically into the snow and weighing the rod and snow core. Snow, in per cent of water by volume, ranges from a minimum of 10 per cent for a new fall to a maximum of about 57 per cent during the spring runoff. Measurements are used as a basis for predicting the summer water supply to an accuracy of about 10 per cent. Surveyors are paid by the state, national park and forest services and power companies and computations are made

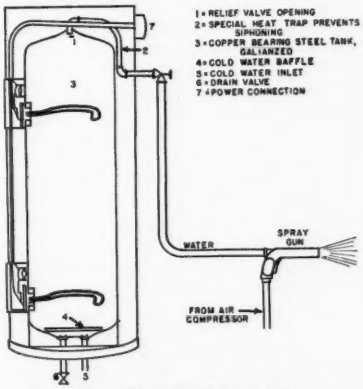
Summer water supply is predicted by snow surveys

by the California State Division of Water Resources at Sacramento.

Hot Water and Air Cleaner

By Paul C. Ziemke

Cleaning of machine and motor parts by the air-water method has been found to have many advanatges over older methods we have used. The equipment consists of an automatic electric water heater, of large size, and with adjustable thermostat and an air spray nozzle together with a convenient length of good hose. The heater furnishes volumes of hot water at 170 deg. and this is mixed with compressed air by the use of an air spray gun, which sprays the hot water on the parts to be cleaned with the effect of live steam.


1 = RELIEF VALVE OPENING
2 = SPECIAL HEAT TRAP PREVENTS SIPHONING
3 = COPPER BEARING STEEL TANK, GALVANIZED
4 = COLD WATER BAFFLE
5 = COLD WATER INLET
6 = DRAIN VALVE
7 = POWER CONNECTION
WATER
SPRAY GUN
FROM AIR COMPRESSOR

Spray Cleaning Equipment

The ready removal of dirt and grime expedites the work and permits more efficient repairs while the expense of operation is negligible since for a small shop the average current consumption is 350 kw-hr. per month, while for larger plants it may reach 700 kw-hr. Neither figure being excessive when the speed and cleanliness of repair jobs is considered.

How Would You Do It?

Faced with an increasing load on his boilers, Our Hero finds that his schedule of operation which has been in operation since the plant was built is causing difficulties. His problem was outlined in the September issue and he asked for assistance in arriving at a solution.

PROBLEM 12
Boiler Operation Schedule

OF COURSE Our Hero expected that engineers would arrive at substantially the same schedule for the operation of his boilers under the increased load conditions which he is expecting—in this he has not been disappointed. What he did not expect was the highly analytical solution presented by Mr. Robinson which not only solves his problem but indicates a very definite method of approach for solving all boiler schedule problems. He has found out how his boilers can be run without severely overloading them, how the combined efficiency will vary with the old and new schedules and what to do in emergencies.

Because Mr. Robinson's solution was the most complete of those submitted in the contest, the judges have awarded him first prize. There were many others, however, who submitted schedules varying in some details from that given in the first prize article. Mr. Grover, the second prize winner, approaches the problem in a somewhat different manner, but arrives at substantially the same schedule; while the third prize winner, Mr. Pef, gives his reasons for recommending an entirely different schedule and comes to the conclusion that Our Hero should replace the h.r.t. boiler with a water tube boiler, which, of course, was not a feature of the problem but should be given consideration in view of the rapidly growing load.

All three of prize winning articles are given in full herewith.

First Prize Award

T. H. Robinson

Marquette, Mich.

THE FIRST step in solving boiler schedule Problem No. 12 is the drawing of a graph showing the future steam load at 25 per cent above the present. By plotting the peaks, lows, and hourly demands, neglecting momentary swings, we get the approximate future load curve shown in Fig. 1.

Inspection shows that the peak load is now 98,000, and the low 32,000. 98,000 is 163 per cent rating for the two water tube boilers, well below 200 per cent, mentioned as being very near the limit for these boilers. We note also that at 163 per cent, the efficiency is only slightly below maximum. Evidently 98,000 can be easily handled by the two water tube boilers.

Should there be an outage of one of the water tube boilers, however, it becomes necessary that one water tube boiler and the h.r.t. handle the load. Inspection of the present daily load curve shows that the h.r.t. is operated for about 8 hr. at nearly 30,000 regardless of its tendency to clinker at 17,500 and over. We will assume that the h.r.t. could deliver 35,000 for a short period with a clean fire, which leaves 63,000 to be supplied by the other boiler at the noon peak. We find 63,000 to be 210 per cent rating for either water tube boiler, only slightly above 200 per cent. Although the efficiency curve for the water tube boilers reads up to 250 per cent, we do not know whether the curve was drawn from actual tests made on location, or is a continuation of the curve plotted at lower ratings, so we select 210 per cent as a safe upper limit. It seems likely therefore that any two of the three boilers can provide sufficient steam to handle the increased load at all times.

We are now ready to draw up an operating schedule, and to examine its workability. It is evident that, because of their higher operating efficiency, and their ability to adjust their output to the load which swings quite rapidly during the day and evening, the water tube boilers should be used as much as possible. Examining the efficiency curve we note very little difference in the range between 110 per cent and 160 per cent of rating for the water tube boilers, remaining nearly at 78 per cent through this range. We note, also, that the water tube boilers have an efficiency of 75 per cent or higher up to 230 per cent of rating, 75 per cent being maximum for the h.r.t. through a very limited range. An average, weighted according to the amount of steam produced by each boiler, shows that one water tube boiler and the h.r.t. give a best combined efficiency of about 77.3 per cent at around 56,000 per hour. We note that the efficiency of two water tube boilers at 56,000 (90.3 per cent rating) is the same as one water tube boiler at 56,000 (181 per cent rating), about 77.5 per cent in either case. Looking along the 56,000 line on Fig. 1, we see that the load is considerably above or below this line during the greater part of the time, and therefore decide to relegate the h.r.t. to standby duty, at least as far as ordinary week day operation is concerned. It may be used, however, to good advantage on Sundays. Typical week day loads seem to require the use of the two water tube boilers, either singly or in combination.

Next step is to determine the proper time to cut in or out the second boiler, that being logically when no appreciable and avoidable loss of efficiency will occur. We have already noted that at 56,000 the efficiency of one or two boilers is the same. We see on Fig. 1 that 56,000 is the load at 7 a. m., that demand continuing for nearly an hour. As this seems to be ideal from both efficiency and operating angles, we decide to cut in the second boiler at 7 a. m., it being evident from Fig. 1 that only one water tube boiler was needed after midnight.

Similarly, the time to transfer all the load to one boiler should be when the demand falls and definitely remains below 56,000 and we find on Fig. 1 that this occurs at about 9:45 p. m.

Now by plotting the efficiencies corresponding to the hourly peak and low demands according to our tentative schedule, we get the efficiency curve shown in Fig. 2. Examination of this curve shows the plant operating at 78 per cent (maximum) efficiency during 8 hr., above 77.5 per cent during another 8, falling only slightly below 77 per cent for 30 min. during the evening. By drawing a line through 77.3 per cent, the best average combined efficiency for one water tube boiler and the h.r.t. in combination, we find that for only two widely separated 1 hr. periods could the load be handled nearly as efficiently by one water tube boiler and the h.r.t. together.

As we discovered before, the water tube boilers operate most efficiently from ratings of 110 per cent to 160 per cent. By drawing another graph, plotting per cent of capacity being used and indicating the limits 110 per cent and 160 per cent, we see that the plant is operating at most efficient ratings for nearly 14 hr. per day, and remaining very close to these ratings during the other 10 hr. We decide that the schedule is satisfactory.

When operation of one water tube boiler and the h.r.t. is required, it is necessary that four things be kept in mind:

First, the h.r.t. must not be operated for long periods above 175 per cent rating because of bad clinker.

Second, the h.r.t. does not respond to a rapidly swinging load.

Third, the rating of the water tube boiler should be kept below 200 per cent if possible.

Fourth, the water tube boiler, which delivers steam at a higher efficiency, should be kept within best range of efficiency if possible.

Assuming 160 per cent rating as that at which the h.r.t. does not give clinker trouble, we cut it in at 7:00 a. m. as per schedule, gradually adding more load at 9:00 a. m. until 350 per cent is reached at 11:20 a. m. and held until nearly noon. The h.r.t is then taken off the line during the noon low and the clinker removed before putting it back on the line at 1:00 p. m. at 160 per cent. The h.r.t. operates at this rating until 6:45 p. m., when its rating is increased between that time and 7:30 p. m. to 220 per cent, after which it is gradually reduced to 160 per cent at 9:45 p. m. when it is taken off the line.

Figure 1 is shaded to indicate how the load should be divided between the h.r.t. and water tube boiler. When the two water tube boilers operate together each will take half the load, as both boilers have the same capacities, characteristics, and operating equipment.

Figure 4 gives two operating schedules, the "revised" using the water tube boilers and the "emergency", using one water tube boiler and the h.r.t.

Figure 5, plotted according to hints mentioned in the problem, indicates that an immediate change to the revised schedule is quite in order.

Second Prize Award

William H. Grover
Manner, Ohio

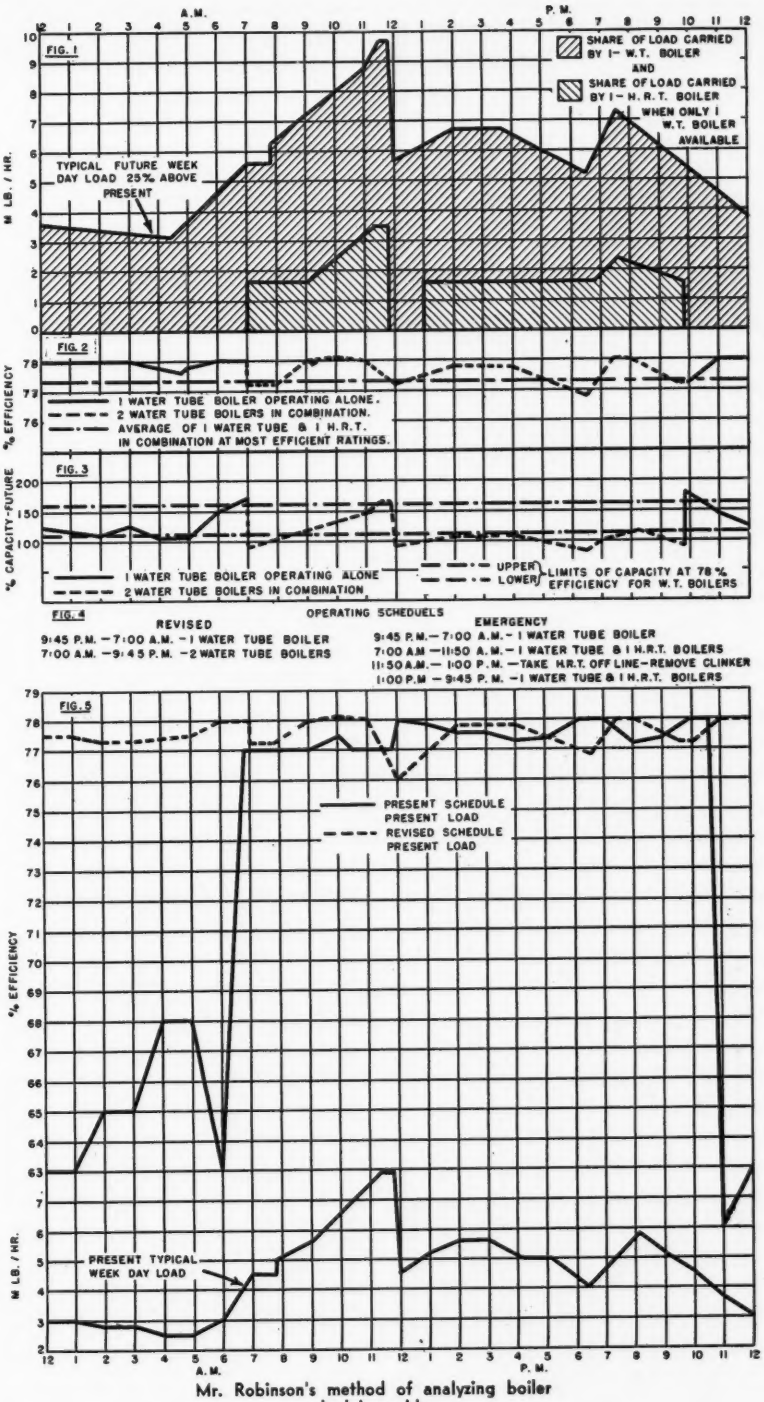
IT SEEMS that you are operating a municipal lighting and power plant. I understand that you have two water tube boilers equipped with force draft travelling chain grate stokers. Each unit has a capacity of 30,000 lb. of steam per hour (30,000 lb. steam per hr.) at nominal rating, and 200 per cent maximum operable rating; one h.r.t. boiler equipped with a single retort underfeed stoker, with nominal capacity of (10,000 lb. steam per hr.), may be crowded to 175 per cent rating but due to clinkers is not practical.

To use the boiler units, you show a typical 24 hr. load curve and state that the load is still growing and that you wish to arrange for an expected load of 25 per cent in excess of that now on the chart.

Referring to the chart:

For purposes of discussion let us divide the day into three parts, beginning with 12 o'clock midnight and continuing until 6 a. m. for the first period; then from 6 a. m. to 12 noon for the second period and 12 noon until 12 midnight for the third period. In this discussion let us refer to these different periods as, Period 1, Period 2 and Period 3.

Period 1: In this part we find an average load on the chart 26,700 lb. of steam per hr. which increased 25 per cent as per specification, amounts to 33,375 lb. steam per hr. while for the maximum the chart read 37,500 lb. steam per hr.; increased to 46,875 lb. steam per hr., while the minimum chart reading was 31,125 lb. steam per hr., increased to 38,900 lb. steam per hr.


A.M.
P.M.
FIG. 1
SHARE OF LOAD CARRIED BY 1- W.T. BOILER AND SHARE OF LOAD CARRIED BY 1- H.R.T. BOILER WHEN ONLY 1 W.T. BOILER AVAILABLE
TYPICAL FUTURE WEEK DAY LOAD 25% ABOVE PRESENT
M LB. / HR.
FIG. 2
% EFFICIENCY
1 WATER TUBE BOILER OPERATING ALONE.
2 WATER TUBE BOILERS IN COMBINATION.
AVERAGE OF 1 WATER TUBE & 1 H.R.T. IN COMBINATION AT MOST EFFICIENT RATINGS.
FIG. 3
% CAPACITY-FUTURE
1 WATER TUBE BOILER OPERATING ALONE
2 WATER TUBE BOILERS IN COMBINATION
UPPER
LOWER
LIMITS OF CAPACITY AT 78 % EFFICIENCY FOR W.T. BOILERS
FIG. 4
OPERATING SCHEDULES
REVISED
9:45 P.M. — 7:00 A.M. — 1 WATER TUBE BOILER
7:00 A.M. — 9:45 P.M. — 2 WATER TUBE BOILERS
EMERGENCY
9:45 P.M. — 7:00 A.M. — 1 WATER TUBE BOILER
7:00 A.M — 11:50 A.M. — 1 WATER TUBE & 1 H.R.T. BOILERS
11:50 A.M. — 1:00 P.M. — TAKE H.R.T. OFF LINE — REMOVE CLINKER
1:00 P.M — 9:45 P.M. — 1 WATER TUBE & 1 H.R.T. BOILERS
FIG. 5
% EFFICIENCY
PRESENT SCHEDULE PRESENT LOAD
REVISED SCHEDULE PRESENT LOAD
M LB. / HR.
PRESENT TYPICAL WEEK DAY LOAD
A.M.
P.M.

Mr. Robinson's method of analyzing boiler schedule problem

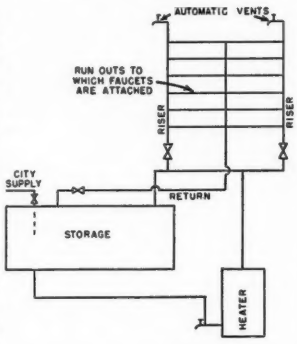
Period 2: Showed average chart reading of 54,000 lb. steam per hr. increased to 67,500 lb. steam per hr. while the maximum shows, 78,000 lb. steam per hr. increased to 7500 lb. steam per hr. and the minimum shows a chart reading of 45,000 lb. steam per hr.

Period 3: We find an average load of 51,800 lb. steam per hr. with the nominal increase amounts to 64,700 lb. steam per hr. The maximum being 57,500 lb. steam per hr. while with increase it amounts to 71,875 lb. steam per hr.; the minimum is 30,000 lb. steam per hr. increased to 37,500 lb. steam per hr.

So far as the load is concerned we have the picture. Now what can we make of it. First let us make a chronological table of these loads connected to

PROBLEM No. 13
HOT WATER SERVICE

One of the Duties of Our Hero is to serve an apartment building with hot water for general domestic use and he has about come to the conclusion that a satisfactory system cannot even be approached, to say nothing of being made a reality. When fully occupied his building serves 200 persons but there is continual complaint that the water is not hot, then too, hot-water faucets sputter and splash whenever water is drawn due to air bubbles that accumulate in the piping. Naturally the management demands of Our Hero to stop this nuisance and he now appeals to readers of the Practical Engineer and Electrician for a solution.



Circulation through a circuit near the heater seems to be poor. It is a two-pipe up-feed system with single pipe run outs on various floors connecting the flow riser to return drop in ladder fashion. Pipe sizes have been checked and found to be amply adequate. The arrangement of the piping is such that the defective risers tend to vent a large part of the system through the return so an air pocket in the return is suspected. The sketch shows the arrangement.

Our Hero is a practical man so he wants the most economical yet positive solution and for this the Contest Editor will give $15. A second prize of $10 and a third of $5 will be awarded on the decision of the judges. All entries should be addressed to the attention of the Contest Editor and must be in the office of Technical Publishing Co., 53 W. Jackson Blvd., Chicago, Ill., by November 25 in order to be considered by the judges.

the events of the day which is as follows:

	Ave. Old Ld.	Ave. New Ld.	Max. Old Ld.	Max. New Ld.	Min. Old Ld.	Min. New Ld.
Part 1.	26700	33375	37500	46875	31125	38900
Part 2.	54000	67500	78000	97500	45000	56250
Part 3.	51800	64700	57000	71250	30000	37500

In considering Part 1, we must be prepared to handle an average load varying as the years go by from 26,700 lb. steam per hr. to 33,375 lb. steam per hr. It is self evident that the fire tube boiler is out so far as handling this section of the load alone, for the reason that the best it can do is 17,500 lb. per hr. which is but little more than half of the minimum for that period. Then of course, we must look to one water tube and we find that its nominal capacity of 30,000 lb. steam per hr. is slightly less than the present minimum, while the boiler at the larger readings will take care of the maximum load of that period on a rating of about 133 per cent, which according to the table, it would show an efficiency of over 70 per cent—not bad. Since we are sort of up a tree with "Hobson's Choice" we will decide right away that the period No. 1 will be the one to be handled by one water tube boiler.

Then let us pass on to Part 2; here we have an average minimum of 54,000 lb. steam per hr. varying to 67,500 lb. steam per hr. with a maximum varying from 78,000 to 97,000 and the least load in that period is 45,000 lb. per hr. It is self evident that we will need at least one water tube boiler to take care of the lightest load. Then looking on the maximum load we find that one water tube and the fire tube have a 265 per cent reading, that under the circumstances would not do. The water tube might do it, and the fire tube might do it, if the coal were changed to a higher fusing ash so that the clinkers would not be a menace. Also the feedwater should be made perfect in order to keep the flame shoots clean; also the furnace volume of both of the boilers should be large enough say, 30,000 B.t.u.'s per cu. ft.

With the information at hand, however, I think we will be satisfied with the two water tube boilers on the second period with an average efficiency of 78 per cent, according to the chart, which I think is too high.

Now we come to Period 3, with an average load of 51,800 lb. steam per hr. varying to 64,700 lb. steam per hr. with a maximum of 71,250 and a minimum of 30,000. One water tube boiler would start on the minimum and carry for some time and would carry to the old maximum with a rating of 190 per cent, which maximum load would finally outgrow the water tube boiler and call into service the fire tube boiler to help out on the peak.

This completes the schedule: First period, one water tube boiler, normal capacity 30,000 lb. steam per hr., with an average rating of 100 per cent, efficiency according to table of 77 per cent.

The second period, we will need two water tube boilers, average rating 102 per cent, average efficiency 77 per cent.

Third period, one water boiler, capacity 30,000 lb. steam per hr. to be helped out with the fire tube when the load exceeds 200 per cent. The fire tube boiler would not be needed on the old load, but somewhere on the new expansion.

The question of the kind of fuel, the furnace volume, condition of draft has a vast influence on boiler ratings and efficiencies, which may change my judgment somewhat. Also the exact time to cut these various boilers in and out, can only be timed according to the load variation. I also take it that the Sunday load will not require anymore than fire tube, which also can only be decided by the man in charge.

Third Prize Award

N. T. Pef
Oak Park, Ill.

THE PRESENT peak being about 80,000 lb. per hr. and allowing 25 per cent increase the peak load to be taken care of is 100,000 lb. per hr. If the capacity of the water tube boilers is increased to about 260 per cent rating the maximum load can be carried by any two of the three boilers and there will always be one spare boiler. At 266 per cent rating the 30,000 lb. per hr. boiler can develop 80,000 lb. per hr. and 20,000 lb. per hr. from the five tube boiler gives the needed 100,000 lb. per hr. The capacity of boilers is limited in the first place by the air supply. If the dampers are wide open and the fans run at full speed the air supply is at its limit and cannot be stretched any further. The fuel supply comes second in limiting the capacity of a boiler but here a little stretching is sometimes possible, especially with traveling grate stokers. By raising the gate and letting some fire go over in the pit the fuel limit can be raised though it must result in waste. In so far as limitations due to refractories these can be stretched considerably when in a pinch.

Increasing the capacity of the water tube boilers may be possible simply by increasing the draft. At any rate this should be done as a first step. A simple test will show whether the limitation is in the forced draft or stack or induced draft or both. With both the forced and stack draft at full opening, if the furnace draft is positive there is an excess of forced draft and if the reverse is true then there is an excess of stack draft whether induced or natural. From this simple test it will be possible to determine which and how much of the two drafts should be increased in order to obtain 266 per cent rating.

It is not likely that the boiler capacity is limited by the ability of the stoker to feed enough coal but if after the draft has been increased there is difficulty to maintain a full fire with the draft wide open, the stoker speed can be increased somehow, by size of pulley, etc., after all the possibilities of higher gate opening have been exhausted. Someone is prob-

ably thinking that if the fuel capacity cannot be increased this way an oil burner can be installed over the stoker. This can be done but I don't think that it will be necessary to go that far.

It will be noted that the work is proceeding "one step at a time" and "pay as you go", and can be stretched over more than a year so as not to strain the budget. If after the capacity of the boiler has been increased it is found that the heavy driving is beyond what the refractories can take, something can be done here, either by the use of high temperature refractories, or air cooled refractory blocks, or by installing a few water tubes in the furnace.

If Our Hero solves this problem by the installation of a new boiler he has my approval and the only reason why I did not recommend that is because I feel that the boss will not OK it. If a new boiler is to be had or can be had my advice to Our Hero is that it be an identical boiler as the water tubes provided they are satisfactory in all respects. It should be installed in place of the fire tube boiler which is to be scrapped.

Assuming that the problem is solved by revamping the two water tube boilers then the schedule of operation is to have these two boilers under fire in normal operation. Two should be on the line from 8 a. m. to 10 p. m. and one banked from 10 p. m. to 8 a. m. the following day. The fire tube boiler is not to be used except when one of the water tubes is out for cleaning or repair. All cleaning and repairs should be done in the summer when the load is light.

As was said, the normal load will be carried by the two water tube boilers. With the exception of from 9 a. m. to noon, the average load will be about 100 per cent for each boiler from 8 a. m. to 10 p. m. From 10 p. m. to 8 a. m. one boiler will have an average load of 100 per cent and the other be banked. With a peak of 100,000 lb. per hr. the maximum load on the boilers will be 167 per cent. Under this operation the efficiency will be about 77 per cent not counting the banking loss. But in case of failure of one of the water tube boilers during the winter time when the load is heavy, with a peak of 100,000 lb. per hr. the maximum water tube boilers will be called to develop 80,000 lb. per hr. or 266 per cent and the fire tube the remaining 20,000 or 200 per cent. The efficiency under this condition will be 72 per cent for the water tube and 73 per cent for the fire tube. But of course this peak period may not last more than a few minutes and ½ hr. at the most which should be easily taken care.

Assuming that the load is equally heavy during the summer and the water tube boilers cannot be cleaned when the load is light, we can allow one month outage per year for each boiler for cleaning and repairs during which time the water tube boiler has to be operated at as high as 266 per cent rating and the fire tube at 200 per cent. This should not pull down the annual efficiency by more than 1 or 2 points at the most.

If a new boiler is to be installed, the schedule of operation is to have two under fire at all times and one in reserve. The main argument in favor of a new boiler is that it will increase the reliability of service, as there will be less chance taking. There will also be 2 or 3 points better efficiency and smaller maintenance

Worthwhile Comments

Another engineer who agrees closely with the first prize winner is Harold D. Brown of Chicago, Ill., who writes: With the load as it is at present, I would operate a water tube boiler 24 hr. a day and use the h.r.t. boiler from about 9 a. m. until the load dropped off in the afternoon, in this way the h.r.t. boiler would carry enough of the load to allow the water tube boiler to be operated at its most efficient output. The loss from carrying the h.r.t. boiler on bank for 10 or 12 hr. a day should not be as much as to carry the larger boiler on bank. The boiler setting for an underfeed stoker should be tight enough to prevent any quantity of air leaking into the furnace to cool off the boiler.

"The h.r.t. boiler does not fit in this schedule due to its low capacity and efficiency," says Chas. E. Markland of Urbana, Ill. When this 25 per cent increase in load does occur, "we would advise scrapping the h.r.t. boiler and installing a new one of 30,000 lb. per hr. capacity in order to have firm capacity or capacity to carry the maximum demand with one boiler out of service."

By coming to the conclusion that Our Hero "should discontinue using his h.r.t. boiler for the light loads and use one of the water tube boilers all the time and keep the h.r.t. unit banked and ready to go whenever the peak load got too heavy for the water tube boiler," Leslie Bradley of Bismarck, N. D., concurs in the majority opinion. He states further that "In using the h.r.t. boiler from about midnight to seven in the morning and then using one of the water tube boilers from seven till eleven or twelve midnight, he should get a boiler efficiency of 75 per cent, but if he used one of the water tube boilers 24 hr. a day, with the h.r.t. boiler kept banked to help only for the few hours that the peak would be excessive then his boiler efficiency should be at least 77.5 per cent which would represent a fuel saving of about 3 per cent."

Frequency of Testing Safety Valves

G. L. Radamaker

THERE has been some argument between technical and practical engineers on the frequency of testing and raising steam safety valves from their seats.

Some technical engineers in order to cut down operating personnel believe that once a month is sufficient to test and raise safety valves, while practical men feel that the safety valves should be tested on a boiler once a week and raised from their seats at least once a day.

Of course with the wide variety of operating conditions in different plants both the technical engineer and the practical operating engineer are neither all right nor all wrong.

The technical engineer's argument is that larger personnel must be used to test safety valves frequently and therefore increases production costs with no apparent advantage. The practical engineer's argument is for safety, and operating costs can go hang if safety must be neglected. Strong as the practical operating engineer's argument appears there is some truth and advantage in the technical man's viewpoint in certain particular cases.

In low pressure and medium pressure plants where load changes are extreme and frequent, there is danger of carry over in boiler water. Since boiler water contains salts that form incrustants these salts would tend to make safety valves stick and then too there is danger of the safety valves not opening at all. In such cases it is wise to raise the safety valves from their seats quite frequently and test the ability of the safety valves to maintain a safe working pressure in the boiler, under any conditions, at least once a week.

In high pressure plants where the steam load is fairly constant and consequently there is little swell in the boiler, there is little chance of carry over as in the aforementioned case. Also high pressure boilers have steam dryers or separators in the steam drum which further prevent carry over. In such cases the added personnel of testing safety valves might be considered an added and wasted expense and therefore the testing of safety valves once a month and raising them from their seats once a week might be condoned.

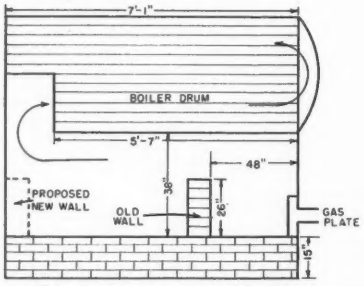
The operating conditions of the plant and the danger of carry over dictate the frequency of attention required by safety valves, but the safety of personnel should not be sacrificed because of the slight added expense to insure safety.

Questions And Answers

Would Change Be Improvement?

INQUIRY by E. G. D. in the August issue, page 77, relates to proposed changes in his furnace design for gas firing in h.r.t. boiler. I would suggest that E. G. D. do as he proposes if he wants to make a simple change, although this may not give all the beneficial results that could be obtained by more elaborate changes.

The gas burner itself does not appear to be very efficient, and apparently there is no premixing with air. If the wall is set back, obviously there will be increased combustion space, but whether or not there will be enough turbulence to properly utilize this space and get intimate mixing of the air and gas is problematic.



This change was proposed by E.G.D.

If the design of burner is not changed, I would suggest removing the old wall entirely and then building three perforated tunnels leading back from a main chamber which would abut the position of the present gas plate which should be removed. Secondary air could be introduced along the bottom of these tunnels through openings outside at the front in the space now occupied by the brick work extending 15 in. below the present floor of the furnace. Openings at the tops of the tunnels should be staggered with respect to those at the sides. Openings from front to rear of the respective tunnels should increase in size to compensate for gas pressure drop. An alternative arrangement which would be even more efficient would be the installation of burners of some burner company who would give expert advice to insure correct operation of their equipment.

Since a non-luminous flame can be attained with higher temperature and less excess air, the fact that it does not transmit as much heat by direct radiation can be remedied by providing secondary radiation from brick work such as the firing tunnels mentioned above. This has been common practice with gas firing on oil cracking stills where it is extremely hazardous to have direct impingement of flame on the heat absorbing surface. In cases where the fixed gas from the process is used, such gas has a very high heat value (20,000 to 23,000 B.t.u. per pound) and will provide an extremely high furnace temperature if such temperature can be utilized. To prevent slagging and melting of the refractories, carborundum bricks are often used. The brick work often becomes almost incandescent, and the heat transmitted by secondary radiation is practically equal to that of a luminous flame. There always is about 10 per cent of the heat in a so-called non-luminous flame transmitted by radiation from the carbon dioxide and water vapor formed as products of combustion. Therefore, assuming 80 per cent overall efficiency, 10 per cent of the heat will be transmitted by direct radiation and possibly 50 per cent by secondary radiation and 20 per cent by convection.

J. R. DARNELL.

Gage Glass Troubles

ON PAGE 80 of the August issue of POWER PLANT ENGINEERING, A. H. P. tells of the troubles he is having with his water gage glass breaking. I had charge of two boilers for 10 yr. and carried 150 lb. gage pressure. At first I bought gage glasses that were thick and some of them had streaks running down the inside of them that looked like they had been scratched. I had considerable trouble with them. They would last sometimes 6 mo. and other times they would break a few minutes after installing them. I finally went to buying the thinner ones, and they had a better glaze both inside and outside. Those glasses lasted much better, from 6 mo. to 2 yr. Some of them, when they would finally let go for a distance of 1 to 1½ in. from the bottom, would be worn down as thin as a thick sheet of paper. I believe, where exposed to a cold current of air, thick glass is subject to greater expansion strains than is the thinner glass which would transmit heat more readily from the inside to the outside surface and thus maintain a more uniform temperature throughout. We blow the water column down three times in 24 hr.

I have found it good practice to put glasses in cold water and heat it up gradually with steam, holding it at high temperature for 2 to 3 hr. and then let it cool slowly. This treatment seems to temper the glasses and has, I believe, helped to lengthen their service.

Redmond, Ore. C. C. COLLINS.

* * *

GAGE GLASS life is a very interesting subject inasmuch as the life of a gage glass is dependent on a large number of factors. First of all, A. H. P.'s one trouble seems to be that the top valve is slightly out of line.

Gage glasses have different lengths of life in different boilers. For instance, a gage glass that is on a boiler that continually primes, even slightly, will wear away to a knife edge, mostly at the top due to the steam surging up and down in the glass.

If the water level is practically constant, as in the case of a boiler that is not greatly forced, the glass will last at least a year. With the boiler that I am now operating, the best life that I can get out of a gage glass is 3 or 4 mo. At the end of that time they start to leak around the top nut and several times I can tighten the nut and it will stop leaking but at last it will not stop and I have to change the glass and, when I do, the glass will be thin as paper at the top end. This boiler is a locomotive type, oil fired.

On return tubular boilers, I have had glasses to last from one inspection to another and they may have lasted longer but I always changed them at inspection periods. I don't believe that the number of times a glass gets blown down a day or whether it gets blown down at all makes any difference on its life but I never clean a glass unless it is compulsory. I believe that a glass should never be disturbed once it has stood the heat. If it gets dirty or smeared and the water is hard to see, it is cheaper to change it.

Baltimore, Md. CHAS. W. PARKS.

Pressures and Temperatures for CO_2 System

I OPERATE and am in charge of a 105-t. CO_2 compressor, used for air conditioning a 1700-seat theater, with air washer and accessories. During the cooling seasons I operate with the following conditions:

Approximate outside temperature, 82 to 90 deg.; humidity, 78 per cent; head pressure, 74 atmospheres; suction, 35 atmospheres. It so happens that often on a busy Sunday the manager will ask if the machine is delivering all the possible refrigeration we can get. Of course the answer is obvious. I explain that the compressor and air washer are giving us all we can get. Using all fresh air and no recirculation.

I am trying to find out if there is any set rule or rules in regard to the suction pressure.

I find that the best results seem to come from adjusting the expansion

valves to a point where the piping leading through the air washer wall is just on the point of frosting. I also find that the adjustment is not the same on all the expansion valves. For instance, the coil nearest the intake will take less gas than the one nearest the fan or air outlet into the fan.

I know you are going to say that you told me under date of July 3, 1936, to carry the suction as high as possible. But I am still trying to find out if there is any given suction pressure for a certain head pressure.

In other words, how can I drag that tank of water below 54 deg. which seems to be the best I can do with the conditions given in this letter?

A. T. K.

IN READING the operating conditions as they are stated, two points stand out clearly:

First, Condenser Pressure. Carbon dioxide has a critical temperature of 88 deg. F. with a corresponding pressure of 1071 lb. absolute or 72 atmospheres gage. At this temperature and pressure the heat content of the liquid and the vapor balance each other with about 59 B.t.u. per lb. each. This means that no condensation takes place and the vapor does not liquefy in the condenser with the result that part vapor and part liquid passes through the expansion valves. Following this reasoning, I suggest that the pressure gages be tested as to correctness.

Carbon dioxide systems can be operated with fair results at close to 88 deg. temperature of condensation by carrying an extra large charge of the refrigerant which will insure a slow travel through the condenser. But full capacity cannot be reached. If the condensing water has a temperature below 85 deg., the present operating conditions indicate either dirty condensers or an insufficient supply of water.

Take temperature readings of the water on and off the condensers. There should be a difference of from 7 to 10 deg. Less temperature difference means scale or dirt is insulating the condensing surfaces, while greater difference means that there is not enough water being circulated. The correct suction pressure to carry will depend on the temperature of the water that is being cooled.

Refer to the tables giving the temperature and pressure relation of saturated carbon dioxide and then carry a suction pressure that shows a saturated vapor temperature 10 to 15 deg. below the water temperature. This will give enough temperature difference to insure rapid heat flow.

The outlet end of the evaporating coils may seem on the verge of frosting, but frost cannot show when the saturated vapor in the coil has a temperature of about 35 deg. which corresponds to the suction pressure of 35 atmospheres. This is another indication that the gages are not showing the true pressures.

The second point—Recirculation of Air. As a general rule from 25 to 50 per cent of the air is fresh from the outside and the rest of it recirculated. Recirculation of up to 75 per cent of the air gives good results in a theater where the air passes through an air washer. A small amount of pine or other deodorant is used to give the air a more pleasing odor.

The amount of heat and moisture is less with the recirculated air and this decreases the load on the refrigerating system.

A. G. SOLOMON.

PRACTICAL HINTS AND KINKS

Compressor Safety Valves

IF, WHEN installing a compressor, there should be insfficient headroom to allow for the customary placement of a relief valve between the compressor and the discharge valve, the machine may still be protected by installing two smaller relief valves at each end of the cylinder, using the vent ports usually provided. Hand vent valves may be included below the relief valves as shown in the illustration.

Two small relief valves protect compressor in cramped quarters

With such protection no harm will be done to the machine or drive even if started against a closed discharge valve.

JAMES P. MARSHALL

West Warwick, R. I.

Preventing Ceiling Sweat in Plants

By W. F. Schaphorst

CEILING SWEAT is a nuisance in plants and men who have worked under corrugated sheet metal roofs, poorly insulated or not insulated at all, have likely known it to almost rain when the outdoor temperature was low and the indoor temperature warm and the air humid. There are two ways in which to prevent ceiling sweat: apply an ample thickness of suitable insulation to the roof; keep the air dry inside of the building or room.

The second is usually the more difficult of the two in power plants due to the presence of hotwells, steam traps, and other vapor sources. It is not necessary to keep the air "perfectly dry"; in fact, it is exceedingly difficult to produce air that is perfectly dry even in a laboratory. But it is necessary to hold the humidity of the air down low enough so that no dew point will be established on the ceiling.

Here is a formula that may prove helpful in computing the limiting relative humidity:

$$H = 100 - K(T - t)$$

where

H = the maximum allowable relative humidity above which the ceiling sweat is likely to form.

K = a constant, depending upon the thickness and type of insulation, as explained in more detail below.

T = the inside temperature in deg. F. usually in the neighborhood of 70 degrees.

t = the outdoor temp. in deg. F.

Values of K for various types and thicknesses of roof construction are as follows:

0.19 for 4 in. of concrete, plus 2 in. of corkboard, plus 5-ply roofing.

0.3 for 4 in. of gypsum composition.

0.5 for 2½ in. tongue and groove spruce planking plus 5-ply roofing.

0.62 for 1½ in. tongue and groove spruce planking plus 5-ply roofing.

0.94 for 4 in. of concrete.

For example, it will be found on checking the above formula that if the 0.19 value for K be used, with a temperature of 70 deg. F. indoors and 10 deg. F. *below* zero outdoors, the relative humidity can be over 80 per cent, and there will be no ceiling sweat. The limit as given by the formula is 84.8 per cent. Therefore, if a relative humidity higher than 84.8 per cent is permitted there will be danger of ceiling sweat.

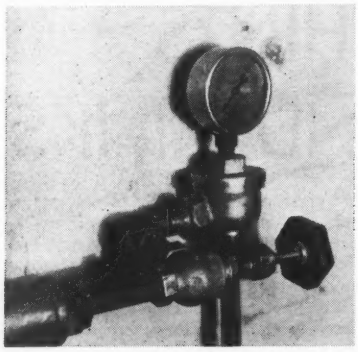
Method for Indicating Flow of Liquids

By Thomas W. Benson

MANY occasions arise where it is desirable to have some means for indicating the amount of water or other liquid flowing in a pipe. Apparatus for this purpose is too expensive to use except in important operations.

Requiring such a device to indicate the amount of make up water flowing to

the feed pump of a small boiler, the arrangement shown in the illustration was assembled by the writer from discarded equipment. It consists of a suitable valve, a discarded thermostatic trap housing and a O-45 pressure gage. The top of the trap was drilled and tapped to take the gage, the element of the trap being discarded.



Pressure gage used to indicate flow

This device was connected into the make up line to the intake of the feed pump and the operation is obvious. The fixed orifice in the trap offers resistance to the flow of the water and as the water valve is opened wider the gage will read higher, thus giving a relative indication of the amount of water flowing to the pump. This arrangement enables the fireman so to regulate the water supply that the water level will remain practically constant.

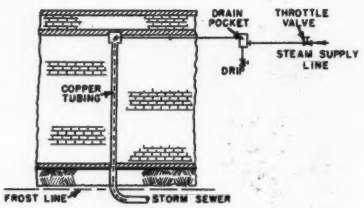
To Avoid Frozen Rain Leaders

By S. H. Coleman

WINTER roofing troubles can, in the majority of instances, be traced directly to rain leaders obstructed by ice formations. This interference with the normal flow of water from roof surfaces and gutters is frequently responsible for leakage, rapid deterioration of roofing materials, the cracking and disintegration of parapet walls, and in some cases, dangerous overloading of trusses and other supporting members. Leakage, surface deterioration, and parapet wall difficulties result from the tremendous leverage exerted by the alternate thawing and freezing of accumulated water. Particularly vulnerable points are overlaps of surface sections, flashing junctions and mortar joints in the walls. Overloading comes from the piling up of ice and snow and may cause sags in the surface or more serious structural troubles.

Many of these difficulties can be avoided if steps are taken to prevent water in the rain leaders or downspouting from freezing. An effective and time-honored method of doing this is to bank the lower ends of the drain piping with fresh manure. The progressive decomposition of this material will ordinarily liberate sufficient heat to insure winter-long protection against freezing at and below the ground surface. Where the climate is moderate the direct rays of sunlight will in most cases be all that is needed to keep the upper sections of these manure protected drains open. If the drains are painted black, heat absorption from sunlight will be measurably increased.

Leaders exposed to more severe climatic conditions require more elaborate treatment. Here again manure will prove valuable but must be supplemented by some method of keeping the upper ends of the drains open in extreme weather and of thawing any ice that may form. Perhaps the simplest method of handling this problem is to provide heat on the interior of the downspout through the medium of a steam line or suitably armoured electrical resistance wire. If steam is the heating medium, it is best applied through metal tubing having its open end well below the frost line. Small diameter copper tubing being highly resistant to corrosion and an excellent heat conductor is ideal for the purpose. Tubing should be sharply inclined downward at all points in its length



Applying steam to rain leader

and be provided with a valved drain pocket close to the main steam control valve. The purpose of this pocket is to afford a means of disposing of any leakage condensate that might enter the system when the control valve is closed and its drain valve should be closed only when the control valve is opened. This will avoid any possibility of the tubing itself freezing up.

Annealing Pipe Welds

IT IS sometimes necessary to anneal welds in pipe lines. This can be done with the pipe in position by first plugging up the pipe ends, then heating the weld and the metal just around it with an oxy-acetylene torch to a temperature of about 1450 deg. F. When this temperature has been attained the source of heating should be withdrawn and the heated area wrapped with asbestos cloth. This will cause the weld to cool slowly and in about 6 hr. the asbestos can be removed and leave the weld thoroughly annealed.

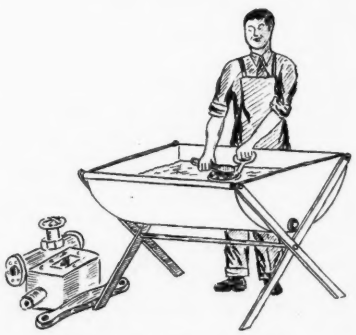
London, England W. E. WARNER

(If you have no other means of measuring the temperature, you will find the color method reasonably accurate after some practice. Full cherry red is about 1375 deg. F. and light cherry red 1550 deg.—Editor.)

Mechanical Helpers Recorded in My Note Book

By Chas. H. Willey

ONE OF THE handiest homemade affairs that the boys have made and used at the plant is shown in the sketch. This is a large parts cleaning tank made from a half of a large oil drum, cut up with

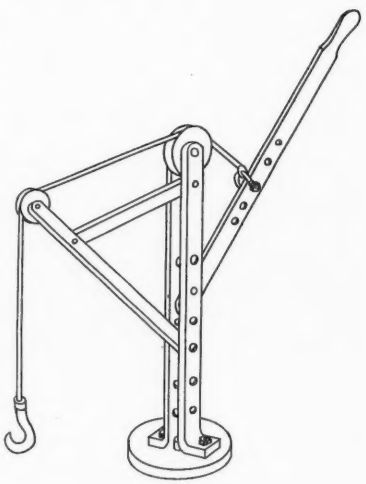


Large Parts Cleaning Tank

a torch and two edges curled over longitudinally to form a holder for the X-leg rack. Is of the folding type so that the tank can be moved about the plant and set up where the cleaning job is to be done. There is also a drain plug to drain off the sludge and liquid.

* * *

OFTEN THERE is a need at the large bench vise for a small crane such as shown in the sketch for handling heavy



Bench Crane

work. The crane is very simple and easily made, and is hand lever operated. The lift is adjustable by moving the pins of the lever to various holes.

* * *

HERE is new thought in the many styles of clamps. Any one using a double screw parallel clamp knows how much bother manipulating the two screws is.

BRINGING boilers up to peak efficiency (AND KEEPING THEM THERE) has become a matter of scientific treatment just as much as is the building up of human bodies. In many respects, the modern methods pioneered by Nalco for correcting and controlling troubles pertaining to the use of water in industrial plants compare favorably with those of the finest clinics.

The results secured with Nalco treatment are attested by typical reports from users: "BOILERS CONTINUOUSLY CLEAN OVER LONG PERIODS OF TIME" . . . "ELIMINATION OF MUCH MAINTENANCE AND CLEANING COSTS" . . . "SAVINGS IN CHEMICALS" . . . "INCREASED BOILER CAPACITY".

We will be pleased to give you complete information about Nalco service. Simply fill out and return the coupon on this page and if received by us before December 15, 1940, we will send you, without charge, a Nalco automatic pearl barrel pencil.

THE Nalco SYSTEM OF FEEDWATER TREATMENT

National Aluminate Corp.
Attention: A. E. Warner
6224 W. 66th Place, Chicago.

Without obligating me in any way, please have a Nalco engineer survey our plant and tell me in what way the Nalco system would benefit my company.

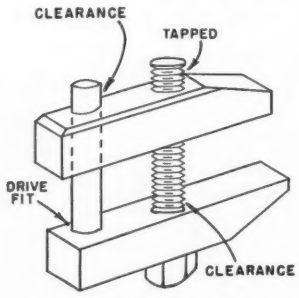
My name is.....Title.....

Company name .....

City .....State.....

Canadian inquiries should be sent to ALUMINATE CHEMICALS LTD., 372 Bay St., Toronto, Ont.

Well try making yourself one of these single screw type of parallel clamps and you will like the design.

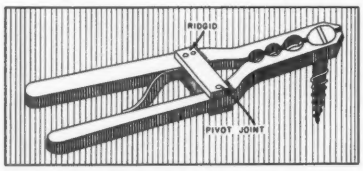


Single Screw Parallel Clamp

It is the same as the conventional style but has a stationary guide post that is a drive fit in the one jaw and guides the other in a clearanced hole as indicated in the sketch.

* * *

THE DEVICE shown in the sketch is called a screw holder for steadying and safely holding screws while starting them. It is made from two pieces of bar stock

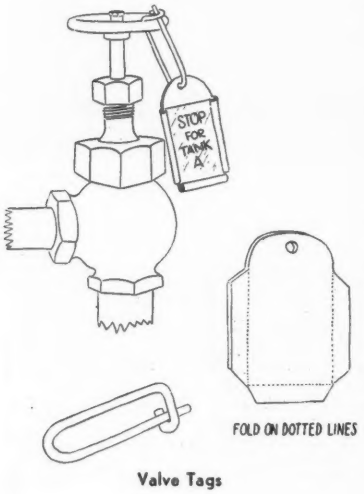


Starting Screw Holder

with a connecting link rigidly attached to one leg and the other fastened to the other with a pivot joint that permits the opening of the jaws. A spring keeps them closed.

* * *

IT IS A simple task to tag infrequently used valves of any pipe line. When plants are first constructed some permanent sort of identification mark should be placed at least on the most important valves and controls. The sketch shows a simple way to make up tags and attaching pins. The tags have provision for insert cards and celluloid covers. Permanent tags of heavy stamped metal should be attached by means of screws to the casting or soldered whichever proves to be the most practical.



Valve Tags

Letters and Comments

Legal Simplicity

I HAVE read your editorial in a recent issue of POWER PLANT ENGINEERING on "Legal Simplicity" and thought readers might be interested in the following which has been in my files for several years. I do not remember where or how it came in my possession, and, as no name is signed to it the author is unknown.

The legal way round — a lawyer thus illustrates the language of his craft: "If a man were to give another an orange, he would say: 'Have an orange.' But when the transaction is entrusted to a lawyer to be put in writing he adopts this form: 'I hereby give and convey to you, all and singular, my estate and interests, rights, title, claim and advantages of and in said orange, together with all its rind, juice, pulp and pips, and all rights and advantages therein, with full power to bite, cut, suck and otherwise to eat the same or give the same away with or without the rind, skin, juice, pulp or pips, anything hereinbefore or hereinafter or in any other means or whatever nature or kind whatsoever to the contrary in any wise notwithstanding.'"

It is a long way round but he evidently got rid of the orange without any claims against himself.

Los Angeles, Calif. ANDREW C. ELDER.

Bigness

OPEN any issue of POWER PLANT ENGINEERING and we see "Bigness."

On the front cover of the June issue, for instance, is shown two Cochrane Deaerators of 300,000 lb. per hr. capacity each for deaerating the feed water for three big boilers.

This means *big things.* Just a very few years ago such things were not considered necessary if they were given even a thought.

Now we know that the big boilers of the present day must be protected from the dangers of corrosion, and the safe operation of all boilers must begin at the boiler feedwater before it enters the boiler.

Does it impress the average engineer when he sees Yarnall-Waring showing pretty pictures of blow-off valves for pressures up to 1500 lb.? This is pressure in a *big way.*

Babcock and Wilcox Co. tells in their advertising about boilers of 375,000 lb. steam per hour at 1375 lb. pressure and 900 deg. temperature. Big boilers, high pressure and high temperature mean high efficiency in steam generation.

Elaborate and complicated apparatus and methods of water purification and corrosion prevention is seldom found in the small industrial plant or in the boiler rooms of such buildings where low pressure steam is used for heating purposes only.

But it is many times too often that our average engineer is not as progressive as he should be.

His boiler room equipment is small and simple when compared with the real *bigness* of large installations. But the fact that steam is generated in all boilers, whether small or big, puts all boilers in the same class as far as care is concerned.

A. G. SOLOMON

Bradbury Heights, Md.

When Accidents Happen

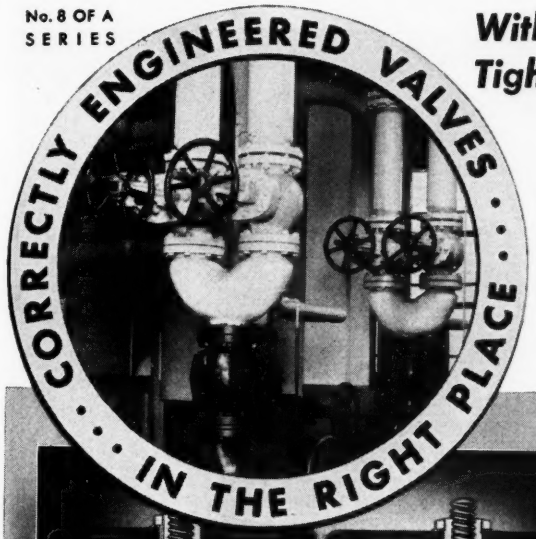
ENGINEERS of today are well trained individuals. Well trained in machines, methods and application. But are they trained to protect themselves and fellow workmen? That is if and when an accident happens?

I am writing about first aid work. How many times have you seen a fireman slap grease on a burn that might have been third degree? How about giving artificial respiration correctly? Can they use an artery clamp? What treatment would they give for a skull fracture with a hemorrage? Can they handle themselves in rescue work, fire, gas? Some of these cases can't wait for a doctor.

I am not a doctor or trying to sell some bandages, just trying to bring something to the front we should consider. How about getting together and learning this "stuff"? Don't just read a few simple directions in a book and let it go at that. You won't remember it. It takes practice. Almost any large industrial company or insurance company will furnish you a trained man to give instructions. One evening a week for six weeks will make you reasonably proficient in first aid if you apply yourself. This training is something you can't buy with money and no one can learn it for you. You may save a life some time because you were big enough to learn it. Let's get the ball rolling by discussions of safety first and first aid practices.

And to you companies and corporations, give your men equipment to work with. We hope you may never need it, but should you, you'll need it badly. Don't put a 50-cent first aid kit in a plant where six to sixteen men work. That would be like taking on an oil fire with a tin cup. Encourage your men, it's as much for your benefit as theirs. JOHN A. GRANT

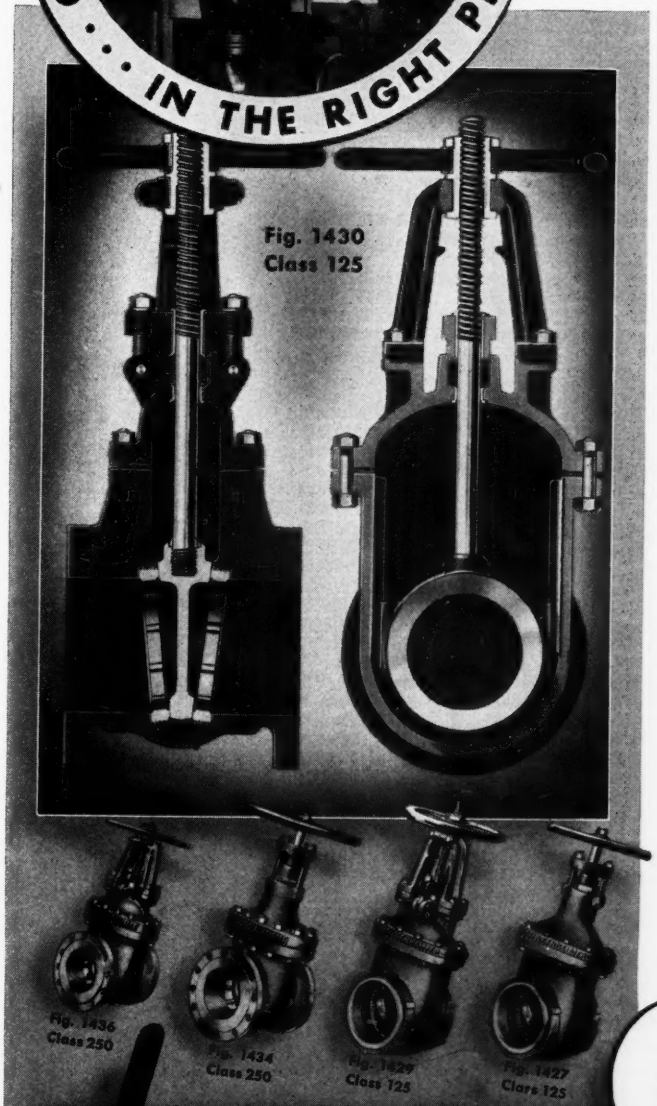
No. 8 OF A SERIES



With Perfectly Guided Tight-Seating Disc . . .

LUNKENHEIMER
Iron Body GATE VALVES

. . . ARE "CORRECTLY ENGINEERED" FOR MAXIMUM ECONOMY ON THE JOB!



● You don't have to be a valve *specialist* to recognize "engineered superiority" in Lunkenheimer Iron Body Gate Valves. Even a casual observer will immediately be struck by their heavy, rugged construction and the obvious quality of the castings employed. Every detail, even to swing-bolts and built-in gland supports which facilitate repacking, bespeaks meticulous care to design a valve that will save the user time and money over long periods of service.

Inside, however, is where Lunkenheimer Iron Body Gate Valves *really* "shine"! Take disc guiding, for example! Not only are the disc channels accurately machined, but the *guide ribs as well* . . . to extremely close tolerances. Chattering or dragging on seats is completely eliminated, assuring tight closure and longer seat and disc life. Exceptionally heavy, bronze seat rings screw into place with inner faces firmly backed up by the solid walls of the body. Discs are of true solid construction—cannot distort when subjected to temperature variations.

SEEING IS BELIEVING!

Space does not permit enumerating all the other important features of these popular valves which assure substantial reductions in maintenance expense and ultimate valve costs. Our distributor, however, will gladly do so. Ask him to take one entirely apart, so you can actually see the superiority our engineers have built into these valves.

●

ESTABLISHED 1862

THE LUNKENHEIMER CO.

"QUALITY"

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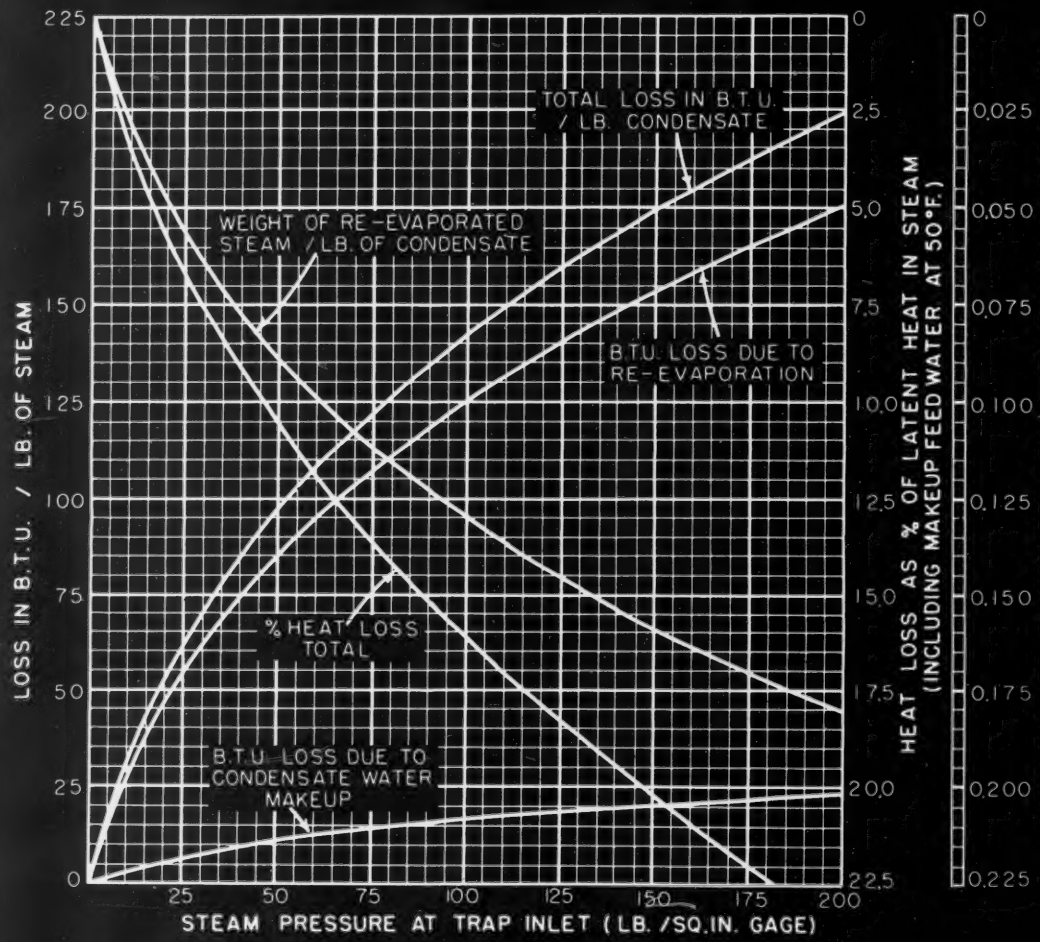
Send for copy of our new Catalog No. 78. We will include our handy "Guide", which makes selection easy by grouping valves, boiler mountings, and lubricating devices according to pressures, temperatures, and service applications.

LUNKENHEIMER

LOSSES DUE TO RE-EVAPORATED STEAM FOR VARIOUS TRAP INLET PRESSURES WHEN OUTLET PRESSURE IS ATMOSPHERIC



COMMON PRACTICE WITH STEAM HEATING SYSTEM FOR COMFORT OR INDUSTRIAL PURPOSES IS TO RETURN THE CONDENSATE TO THE BOILER FOR REUSE. THE USUAL ARRANGEMENT IS TO PROVIDE TRAPS THAT DISCHARGE THE CONDENSATE COLLECTED FROM THE SYSTEM INTO A HOT-WELL OR RECEIVER PROVIDED WITH A VENT TO ATMOSPHERE. THIS RESULTS IN THE CREATION OF RE-EVAPORATED OR FLASH STEAM, DUE TO THE LOWER PRESSURE ON THE OUTLET SIDE OF THE TRAP, AND CONSIDERABLE HEAT LOSS. THE AMOUNT OF THIS LOSS HAS BEEN CALCULATED BY S. G. SAUNDERS AND PRESENTED IN A PAPER BEFORE THE INSTITUE OF HEATING AND VENTILATING ENGINEERS OF ENGLAND WHICH IS THE SOURCE OF THE CHART GIVEN HERE.

Measuring Reservoir Capacity From Twenty Thousand Feet

Improved technique and equipment extends the scope of aerial survey work. With new type planes and contour finder, surveys that formerly required six months can now be completed in a matter of three weeks

ONE of the important contributions which the field of aeronautics has made to the hydraulic or, more specifically, to the field of civil engineering, is the art of aerial surveying. More and more this method of surveying is coming into use where large areas are involved. A number of utility firms have adopted this method in making surveys in planning new transmission lines or for analyzing hydroelectric reservoir possibilities. Today it is a relatively simple matter to transpose photographic data taken at 20,000 ft. elevation, to the drafting board in the hydroelectric design rooms.

This method of surveying saves much time and effort and is highly accurate.

To point to a specific example, aerial "mosaic maps"—photographs taken from special mapping planes and pieced together in a topographic pattern—were recently being fitted together by engineers of the Abrams Aerial Survey Corp. of Lansing, Michigan, to determine the actual capacity of a huge reservoir being constructed by the Wisconsin-Michigan Power Company near Crystal Falls on the Michigamme River in Michigan's upper peninsula.

The high water contour line was easily determined. The problem, however, was to quickly ascertain the contour lines at 10-foot intervals inside the high water line. This done, the capacity was very accurately measured.

Using a set of stereoscopic photographs covering the entire area of the new dam site and reservoir, the newly-perfected Abrams contour-finder was pressed into use.

(Continued on Page 92)

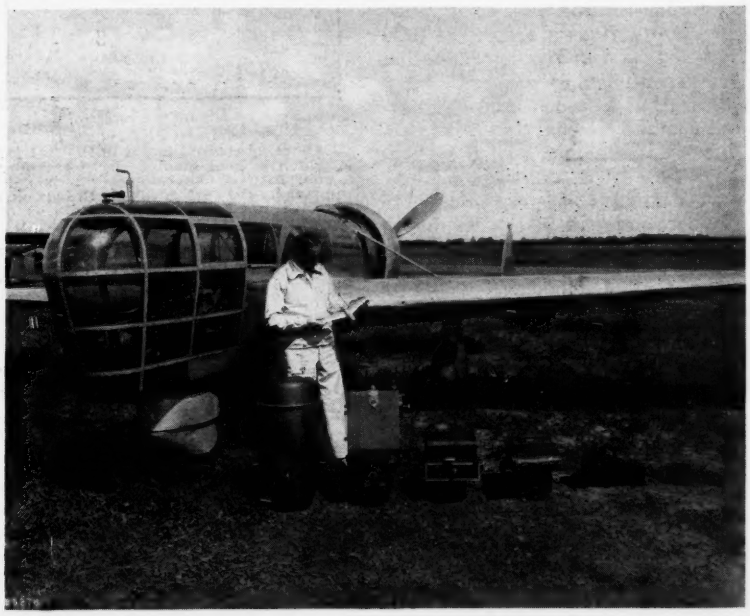


Fig. 1. (Above) The "Explorer" pusher type airplane with unobstructed view in all directions, used in modern aerial survey work

Fig. 2. (Right) By means of the contour finder, contour lines are transferred to paper directly from the mosaic maps. This device uses the principle of parallax measurements to determine vertical elevation from stereoscopic photographs

The Significance of an Oil Analysis

Part II. A further exploration of the determination of oil characteristics and correlation of these characteristics with actual service conditions. Carbon residue, cloud and pour points, emulsification, neutralization number, evaporation and sulphur content can be determined quite accurately but most of them appear to have little relation to service requirements. E. P. lubricants required for high tooth pressures and rubbing velocities

By Harold E. Rose

PETROLEUM PRODUCTS are highly complex mixtures of hydrocarbons, varying widely in chemical and physical characteristics. Due to these variations in composition, some products are vaporized with relatively little residue, while others deposit an appreciable amount of non-volatile, carbonaceous matter. It is this residue or deposit which is termed "carbon residue." This residue may vary in structure from a fine, soot-like substance, easily removed, to a hard, dense adherent material which is removed with extreme difficulty. Generally, oils of naphthenic origin produce a carbon residue which is soft and soot-like in nature, while paraffin crudes form the hard, dense products. The percentage of carbon residue is normally higher in paraffin oils than in those of naphthenic origin.

This method used to determine this is a modification of a procedure devised by Conradson and oftentimes referred to as Conradson Carbon (A.S.T.M. D189-36[1]). It is usually applied to oils subjected to vaporization or partial combustion at high temperatures, as in an internal combustion engine, air compressor, high-pressure steam engine, etc.

Carbon residue is determined by heating a given quantity of oil (approximately one-third ounce) in apparatus so designed to exclude air, thus subjecting the oil to an action of destructive distillation. After heating for about 30 minutes, the equipment utilized is allowed to cool and the residue is weighed. The result is reported as percentage of carbon residue.

The original purpose of this test method was the determination of carbon-forming properties of a lubricating oil when used in internal combustion engines. Not infrequently is it claimd that the quantity of carbon deposited in combustion chambers is proportional to the percentage of carbon residue in the oil. With ideal conditions, this is possibly correct, but it is definitely not correct when applied to the average operating conditions.

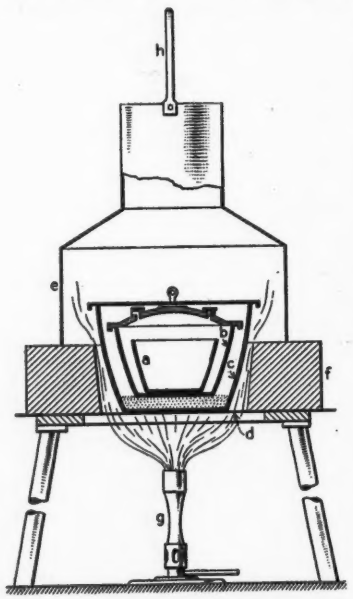


Fig. 1. Apparatus used for determining the carbon residue (A.S.T.M. D 189-39)

The sample is put in a porcelain or silica crucible a, both placed in iron crucible b, which in turn rests on sand in iron crucible c. The entire assembly fits inside the insulator block f and rests on a wire support d, where it is heated by the burner g. e is a sheet iron hood.

Factors such as engine design, oil viscosity, temperatures, loads, type of fuel, etc., influence to a great extent the ultimate amount and character of carbon deposit. Hard, abrasive carbon is a detriment since it promotes wear on cylinder walls and bearings. Carbonaceous deposits which are tarry in nature have a decided effect upon operation when deposited on spark plugs, pistons, rings, valves and valve seats. The quantity and nature of the carbon residue of fuel oils is important for use with oil-burning equipment.

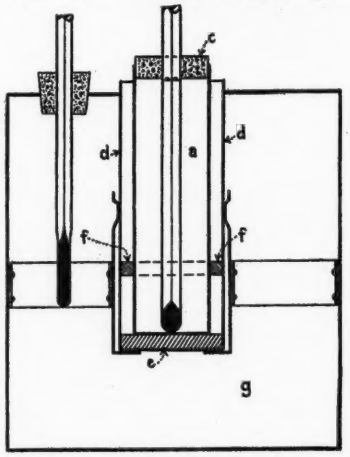


Fig. 2. Cloud test apparatus (A.S.T.M. D 97-39)

About 2 in. of oil is put in the test jar a, which is held in place by e and f in a cold bath g. Thermometer b is held in place by the cork c. The bath is cooled in steps until a distinct cloudiness or haze appears at the bottom of the jar. For the pour point the oil is chilled until the test jar can be held in a horizontal position 5 sec. without movement of the oil.

Cloud and Pour Points

The Cloud Point of an oil, by definition (A.S.T.M. D 97-34[1]), is that temperature at which paraffin wax or other solid substances begin to crystallize out or separate from solution when the oil is chilled under definite prescribed conditions. This determination is of little value, except when the application is wick-feed service at low temperatures. In such cases the formation of wax at a critical temperature would interfere with wick flow. The presence of moisture in the oil will give misleading results due to water separation, a factor of considerable importance in evaluating cloud point results.

The Pour Point of an oil is the lowest temperature at which an oil will flow when cooled under certain prescribed conditions. It will indicate the temperature below which

[1]Editor's Note: Detailed laboratory equipment and test procedure is included in the A.S.T.M. standard methods of test indicated in parenthesis throughout the article. These may be found in Part III of the bound volume of A.S.T.M. Standards—1939. Individual copies of each standard can also be obtained for 25 ct. per copy from the American Society for Testing Materials, 260 S. Broad St., Philadelphia, Pa. They may be ordered by the designation number given in the article. These standards are identical with those adopted by the American Standards Association and the American Petroleum Institute but each society uses a different designation.

channeling is to be expected since the oil has lost its fluidity. The test procedure is one devised to determine low temperature characteristics and does not indicate the quality of a specific product. It actually offers information relative to the temperature at which an oil may be poured from a container or will flow in a gravity-feed system. Pour point results will not indicate torque reactions in low temperature operation or ease of engine starting. These factors depend upon crankcase temperature.

The pour point generally indicates the temperature at which sufficient waxes or solids have formed to prevent free flowing of the oil. The exception to this generality is certain naphthenic base oils in which the resistance to flow is the result of increased viscosity rather than the presence of solidified constituents. Naphthenic oils, by nature, have lower pour points than paraffin products, but modern dewaxing methods are capable of producing paraffin oils with comparable pour points.

Determination of cloud and pour points is accomplished in the following manner: A test jar or a 4 oz. oil sample bottle is filled half-full with the oil to be tested. A suitable cork is fitted and a thermometer inserted through the cork into the oil. This assembly is then placed in a metal cylinder, the diameter of which is slightly larger than the test jar, and the whole placed in a cooling bath capable of reducing the temperature below the pour point. The test jar is examined frequently and the temperature at which the oil shows a distinct haze or cloudiness, due to wax or other solid formations, is recorded as the cloud point. The sample is further cooled in the freezing bath to a temperature at which the oil ceases to flow when the jar is tilted, 5 sec. being allowed for movement. This temperature is considered the pour point.

Demulsibility and Emulsification Tests

A mixture of oil and water tends to separate upon standing at a somewhat uniform rate. The rate of separation, however, is dependent upon the presence or absence of impurities such as dirt, oxidized oil, acids, sludges, etc., which aid in the formation of emulsions and retard rapid or complete separation. A knowledge of the separation ability of an oil is desirable in steam turbine service, for example, where the lubricant may contact steam or water. Here the formation of emulsions, due to the inability of the oil to separate rapidly, may cause bearing failure by the clogging of oil lines.

Conversely, the ability of an oil to emulsify is highly desirable in oils used for certain types of steam engines, marine lubrication or as soluble oils in metal fabrication. Two methods are employed in the determination of emulsion characteristics, Herschel Demulsibility and the A. S. T. M. Steam Emulsion Test.

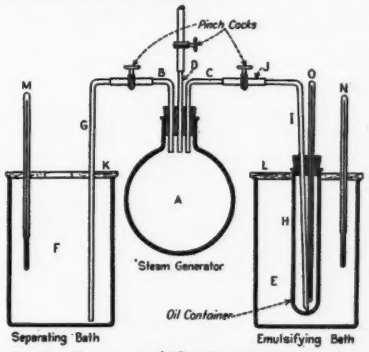


Fig. 3. Steam emulsification test apparatus (A.S.T.M. D 157-36)

Steam from A bubbles through a sample of oil in the tube H until the condensation equals the oil volume. It is then transferred to bath F and the time required for the oil to separate is the emulsification number. If they do not separate in 20 min., the oil is reported as 1200 plus. Tests should not vary more than 10 per cent.

The Herschel Demulsibility test consists of churning together 27 cc. of oil (approximately 1 oz.) and 53 cc. of distilled water (approximately 2 oz.) for 5 min., maintaining a temperature or 130 deg. F. throughout the entire test. At the conclusion of the churning period, the oil and water are allowed to separate and readings relative to the quantity of oil settled out observed every minute. An oil is assumed to have a perfect demulsibility when complete separation occurs within 1 min. This method is number 320.32 in the Federal Specification[2] VV-L-791a, and commonly referred to as the Herschel Demulsibility Test.

The A. S. T. M. Steam Emulsion Test (Method D 157-36) consists of condensing steam (according to prescribed conditions) in the oil sample being examined until the emulsion thus being produced reaches a definite volume. The steam source is then removed and the time in seconds required for the separation of 20 cc. of oil from the condensed steam is recorded as the Steam Emulsion Number. Samples requiring in excess of 20 min. for separation of the required volume of oil are reported as Steam Emulsion Number 1200 plus.

[2]Lubricants and liquid fuels, general specifications (methods for sampling and testing) Oct. 2, 1934. Price 15 ct. from the Supt. of Documents, U. S. Government Printing Office, Washington, D. C.

Neutralization Number

The Neutralization Number of a petroleum product is a means of expressing the quantity of: (1) organic compounds having acid characteristics, (2) mineral acids, (3) free alkali. Technically, the term applies to the weight in milligrams of potassium hydroxide required to neutralize one gram of oil. The determination (A. S. T. M. Method D 188-27 T[1]) is strictly chemical in nature and requires laboratory equipment for its performance.

Mineral acids and free alkali are seldom encountered in lubricating oils and their presence indicate poor or careless refining practice. Unquestionably, such substances in excessive amounts are dangerous since they will corrode or pit metallic surfaces and accelerate sludge formations.

Organic acids are extremely complex and difficult to determine. They are not necessarily harmful in a lubricating oil, in fact, recent investigations give some evidence, although not definitely conclusive, that the presence of organic acids probably improve the oilness or friction-reduction characteristics. The danger arises when high acidity is developed in circulating systems exposed to moisture and air, and at high temperatures.

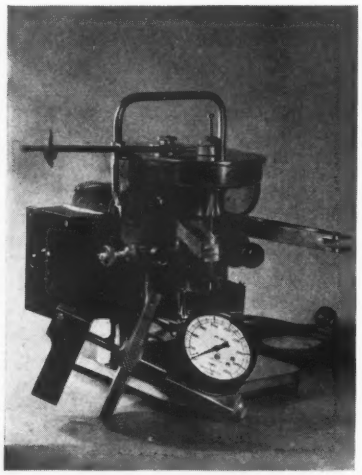
Here the organic acids become very active and tend towards the corrosion of metal surfaces. Sludging tendencies are increased and deposits of sludge solids not uncommon. Logically, this test is of paramount importance in maintaining the quality of turbine oils in service. The increase in Neutralization Number from month to month should be gradual and somewhat uniform.

Evaporation Tests

Laboratory evaporation tests are many and varied, and generally of little value in estimating the suitability of an oil. This is due to the fact that the rate of evaporation will not remain constant with changes in operating conditions. For example, two oils heated in an open container for a specified time at 200 deg. F. may have the same rate of evaporation. However, if the temperature is increased to 250 deg. F., they may give evidence of vastly different

rates of evaporation. The most logical method of determining this factor is by a test run with the equipment with which the oil is to be used.

It has been suggested that information from the flash test is indicative of evaporation tendencies. Generally, oils with high flash points evaporate more slowly than those with lower flash points, but current data has failed to establish direct relation between the two. Oils having identical flash points often vary greatly when subjected to evaporation tests.



Load test machine

Flash tests can only be considered qualitative when applied to evaporation investigations.

Sulphur Content

Rarely are petroleum products totally free from sulphur and, in general, the content is of little significance unless the oil is to be burned. In such instances the sulphur dioxide resulting from combustion may be objectionable. This is particularly true in internal combustion engine use where moisture is likely to be present. Sulphur dioxide gas escaping as blow-by is absorbed by water present in the crankcase oil and forms sulphurous acid. This is immediately oxidized to sulphuric acid, and the effect of this acid on metal surfaces requires no comment. Motor or Diesel fuels seldom contain sulphur in quantities great enough to produce this effect. The sulphur compounds present in fuel oil for industrial uses are readily combustible and difficulty seldom experienced.

E. P. Lubricants

The past few years have witnessed the introduction of so-called "E.P." (Extreme Pressure) lubricants. These lubricants unquestionably permit greater pressures between rubbing surfaces without scoring or galling than can be withstood by straight mineral oils. Why and how they accomplish this phenomenon is largely controversial and numerous theories have been advanced. It may be that chemical compounds are formed on the bearing surfaces, thereby increasing the resistance to rupture of the oil film. Regardless, equipment employing high tooth pressures and increased rubbing velocities impose loads which can only be carried by E. P. materials.

Variations in composition of these materials are as numerous as the theories advanced for their functioning. The most effective products depend upon sulphur and/or chlorine as active ingredients, while lead soap, in combination with either, offer certain advantages. The active ingredients must be loosely bound to be effective, thus introducing additional factors, such as chemical stability, resistance to corrosion, increased propensity to wear, oxidation tendency, etc. These properties are essential and must receive careful consideration. Two types of E. P. lubricants are generally available: the mild or conventional type and the powerful type. This classification is based upon the load-carrying ability of the product as measured by mechanical test methods.

There is available a number of machines designed to indicate and evaluate the load-carrying characteristics of these lubricants. Some of the more widely known are: Almen, Falex, Four-Ball, General Motors, S. A. E. (Society of Automotive Engineers) and the Timken machine. Unfortunately, they have one fault in common—inability to correlate test machine results with service conditions. It is reasonable to assume, therefore, that data which bears no relationship to service can be of little practical value. In the final analysis, a lubricant is produced for the lubrication of mechanical equipment in operative service—not to lubricate a specific test machine. In view of these facts, too much emphasis should not be placed on the results of test machines when selecting an E. P. lubricant.

Editor's Note: A third article discussing the significance of a grease analysis will appear in an early issue.

(Continued from Page 89)

Measuring Reservoir Capacity from Twenty Thousand Feet

The contour lines were then drafted directed to scale, using the principle of parallax measurements to determine elevation from stereoscopic photographs.

Before the contour map could be completed it was necessary for field engineers of the aerial survey firm to identify several control points of known elevation on the photographs. These points were widely scattered as compared with ordinary ground survey methods, and were used as bases for inception of the contour-finder operation which unerringly told the utility men what capacity they might expect.

The entire operation required only three weeks after location of the control points, whereas, in normal ground survey operations, this method would require a period of six months. The aerial survey method was recently recommended by Murray D. VanWagoner, Michigan State Highway Commissioner, who announced that aerial photographs would replace the usual field surveys in planning the Detroit Northwest Express Motorway, 14 miles in length, one of the most important arterial routes in the state. The completed mosaic strip map will show all existing structures for 300 feet on each side of Grand River Avenue, including telegraph poles and manhole covers in the street, thus, according to Commissioner VanWagoner, yielding valuable data on location of public utility lines.

As demand from private and public utilities and municipal public works departments has increased, the Lansing, Michigan, firm has perfected its own type of special mapping plane—the unique "Explorer" pusher-type craft with unobstructed view in all directions. The latest edition of the "Explorer," the PC-4, now on the drawing boards, will carry its mapping crew into the substratosphere in a super-charged, cylindrical cabin, in the near future. Park planning, timber cruising, geologic and utility survey will comprise a few of the many activities of the "Explorer"—and its diminutive companion-piece, the contour-finder, will enable engineers to plan their projects to the minutest fraction.

New Equipment

Information that you desire about any equipment will be gladly furnished without obligation. WRITE POWER PLANT ENGINEERING.

New Brookville Locomotive

A NEW series of industrial locomotives, in 4, 5 and 6 t. weights, is now available with the UD-6 International Diesel engine. This engine is a four-cylinder, four stroke cycle, full Diesel, developing 39 hp. at 1500 r.p.m. The

UD-6 Diesel engine has high torque at slow speeds which give it the lugging ability of a steam engine. Its smooth flow of abundant power is applied to all four locomotive drive wheels through four forward and four reverse speeds, the latter of which are made available by the Brookville reverse gear operating in conjunction with a heavy duty, four-speed transmission. The work capacity of the locomotive is further increased by the use of steel tires, which increase traction by a full 25 per cent over chilled face drive wheels.

Other features of the Brookville locomotive include: dual spring journal suspension, which permits high speed over poor track; an indestructible steel frame; Timken bearings; and use of standard "International" parts in the engine clutch and transmission, to permit after sales field service by any International Harvester branch. Available in any gage, with or without cab, standard or mine types.

Tube Cleaners

The Airetool Mfg. Co., Springfield, Ohio, has recently completed an important development in its tube cleaning motors. Improvements were made on the cylinder, rotor and rear head and the new motors tested under actual

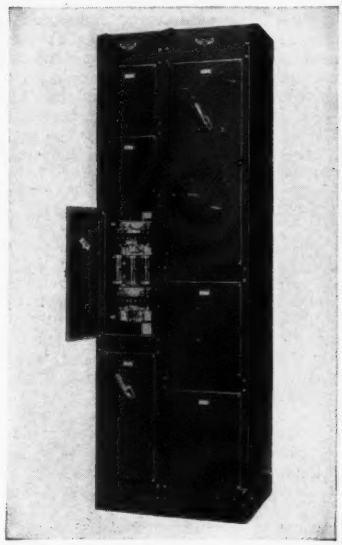
working conditions are said to develop 28 per cent more power than any motor that Airetool has ever tested.

This power increase brings with it a number of advantages. The use of more cutter head combinations is made possible so that even the most severe encrustations can be combated without tube damage or metal removal. Constant torque at low speeds prevents the motor from stalling. There are no dead centers. Motor will start under heavy loads and will pick up instantly when air is applied.

These new motors are designated: Airetool No. 4000 Series for bent tubes and No. 5000 Series for straight tubes.

Cutler-Hammer Unitrol

UNITROL a new engineering idea in Motor Control installation. Built on the same principle as today's sectional filing cabinets, this latest development permits all needed types of control devices to be organized in locker-like Motor Control Centers instead of the usual "pillar and post" method of mounting.



The standardized construction allows quick building up of any unitrol control center to meet present requirements—and without special engineering. Future changes due to expansion, shop layout changes, etc., are quickly and easily taken care of by adding or removing sections, or by replacing the unit controllers. This feature—pre-engineered flexibility — will be of special value in the present period of industrial expansion for national defense . . . building new plants, remodeling and expansion of present facilities.

With Unitrol construction standard Motor Control units are mounted in standardized cubicle sections (see illustration). These sections are made in 32 sizes; 8 widths, 4 heights (one depth)—for mounting any desired combination of units. Standard units can accommodate controllers, disconnect switches and accessories as required. Control units can be mounted in both front and rear of the section giving double sided construction and an economy of space hitherto unknown. The sections may be installed in a straight line, an L-shope or a U-shape in which case it literally forms its own control room.

Units are assembled either with all wiring buses, supports, terminals and interconnections already made, or with provisions for wiring it on the job.

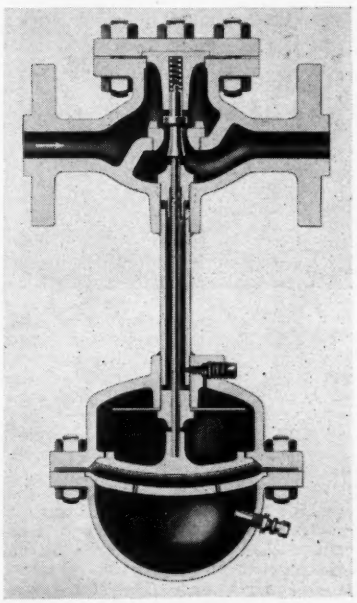
Blank steel panels are furnished for any unused sections. Pushbuttons, meters and other accessories may be mounted on the blank panels. A door swing-out feature facilitates wiring and change-overs.

With Unitrol there is no supporting structure to fabricate; no wall or floor preparations; no special engineering. Its known dimensions and predictable costs permit intelligent planning of present and future motor control installations.

A descriptive booklet "Unitrol—the next stop forward in Motor Control" is obtainable from Cutler-Hammer, Inc., Milwaukee, Wis.

Pressure Regulators

Foster Engineering Co. announces its "most outstanding automatic valve development," the Type 39 (Q1 single seated and Q2 double seated) pressure reducing regulators, for steam, hot liquids and hot gases for: initial pressures up to 2500 lb.; final pressures up to 1200 lb.; and temperatures up to 1000 deg. F.



The valve is designed to handle pressure reductions of a magnitude previously considered impractical in a single stage. Accurate adjustment of

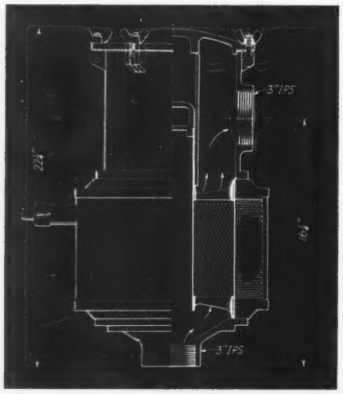
reduced pressures from 5 lb. up to within a few pounds of the initial pressure is made positive and simple by the air dome-loading design.

There are no operating springs in this simple regulator, and no stuffing box. A constant loading is imposed by air, thereby insuring constant regulation. Accuracy is unaffected by spring deflection and hysteresis; the pilot design commonly used to overcome these inaccuracies is not necessary in this simple construction. It is as positive as direct weight loading.

Additional features claimed are: accurate and sensitive regulation insured by constant air load in dome; single seated for dead-end service, shutting in direction of flow for tight closure, double seated for continuous-flow service; simple to set over the widest range of pressures with no springs or weights to adjust or change; single-stage reductions of extreme magnitude without hunting or chattering; diaphragm is shielded from differential pressure stress and should it fail, the pressure equalizes and the valve closes; full valve travel with little regulated pressure variation; a minimum of moving parts, no large sliding surfaces or side thrusts, and no stuffing boxes to bind, or to pack; parts are readily accessible and renewable without removing body from line. No special tools are required; can be adjusted at a distant control point by an extension loading tubing for hand pumping or by a pilot control valve.

Magnetic Oil Filters

FERROFILTER is the trade name of a magnetic separator, made by the S. G. Frantz Company, Inc., 161 Grand Street, New York, N. Y., is applicable



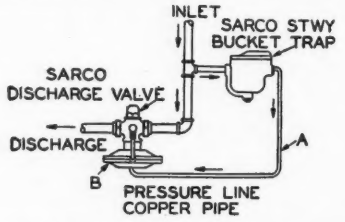
to a wide range of industrial and lubricating servicing wherever large quantities of oil are circulated. It is essentially a set of magnetized screens and is said to extract abrasive iron particles and other magnetic materials as fine as one micron—material which passes through conventional filter's screens.

Tests show that the use of the separator or filter effect a marked reduction in oil oxidation and free acidity. Details of these tests by an independent laboratory, with and without the application of FerroFilters on internal combustion engines, are available upon request.

Features of the device are; full flow; low pressure drop; high capacity; non-clogging operation; no moving parts; no replacement parts to buy; rugged construction; quick cleaning; and, non removal of oil additives. The filter is located close to the machine or engine in the oil pipe line and becomes part of the circulating oil system.

Indirect Steam Trap

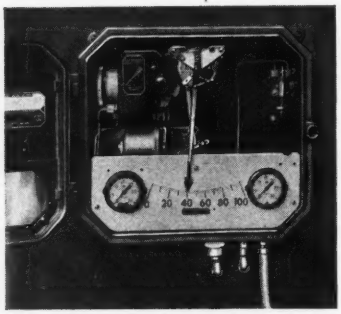
SARCO CO., INC., New York, N. Y., manufacturers of steam specialties, announce the addition to their line of an indirect steam trap of very large capacity and suitable for pressures up to 175 lb. p.s.i. As shown in illustration, the arrangement consists of a standard Sarco inverted bucket steam trap of small size,



coupled to a special diaphragm valve in the condensate discharge line. The valve is normally closed. When condensate opens the discharge valve of the pilot trap, pressure reaches the large diaphragm of the main valve and opens it wide. It is held open as long as condensate flows but shuts tightly as soon as the trap closes. Since the valve has full nominal area and is available in sizes ½" to 2½" inclusive, very large volumes of condensation can be handled by this simple arrangement. This combination trap is known as type BSDE.

Remote Pneumatic Transmission System

A SIMPLE, accurate and in many instances the only practical and economical means of indicating, recording or controlling process variables remote from the point of measurement is offered by the new Taylor Remote Pneumatic Transmission Systems. This new system of remote transmission, a product of Taylor Instrument Companies, Rochester, N. Y., is particularly advantageous where it is desirable to correlate temperature, pressure, flow or liquid level data on a centralized panel or in a control room.



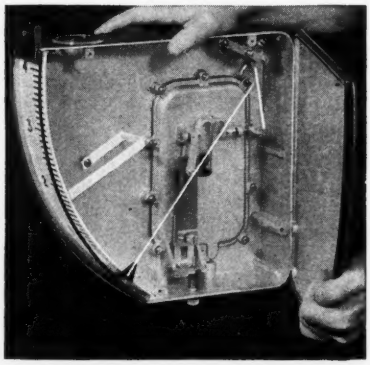
The system utilizes standard Taylor instruments. It may consist of one or two transmitters connected to a receiver; or one or more receiving instruments, not necessarily near each other, and as far as 1,000 feet from the transmitter. Transmitters or receivers may be indicating, recording or controlling types. Air pressure is the transmitting medium, with ¼ in. O.D. copper tubing as the means of connection.

Taylor Remote Pneumatic Transmission Systems are highly accurate—well within ± 1% of the scale range when properly installed. The speed of response of the receiver to changes in output air pressure from the transmitter is largely dependent upon distance—the maximum lag being 1 second per hundred feet of connecting tubing.

The new Taylor system eliminates the hazards of electrical transmission by doing away with electrical circuits in explosive atmospheres. It measures, transmits and receives continuously regardless of electrical current failures.

New Multi-Point Indicator

REPUBLIC FLOW METERS CO., Chicago, Ill., announce a new multi-point indicator, for indicating drafts, pressures, differentials, and other factors in boiler and industrial furnace operation. Zero adjustments and all piping connections for each gage unit are accessible from the front of the panel and each unit is designed to be withdrawn, like a book from a shelf, without disturbing other units. Each gage is actuated by a very sensitive dry-bellows



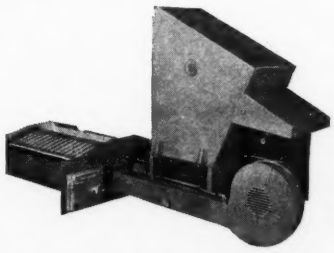
type of diaphragm for ranges from 0 to 50 in. of water or by a helical element for pressures above 50 in. of water. The gages have 12-in. vertical, translucent, rear-illuminated scales. The new indicator is supplied with from 2 to 16 of these compact, interchangeable gage units, and is built for either flush or projected mounting.

Anthracite Stoker

UTILIZING reciprocating ram blocks in the retort and also reciprocating grates, Iron Fireman engineers have developed a means of firing anthracite coal in commercial-size boilers with new high efficiency. These engineering developments are embodied in the new Iron Fireman Series 35 commercial anthracite stokers. The stokers are designed for high and low pressure steam boilers, hot water boilers, and for industrial applications. Nine sizes are available, for loads ranging from approximately 25 to 140 b. hp.

These stokers are the "poweram" underfeed type, which use a metering type worm to deliver the coal from

the hopper to the retort, and reciprocating coal distributors in the base of the retort to distribute the fuel uniformly throughout the length of the retort.



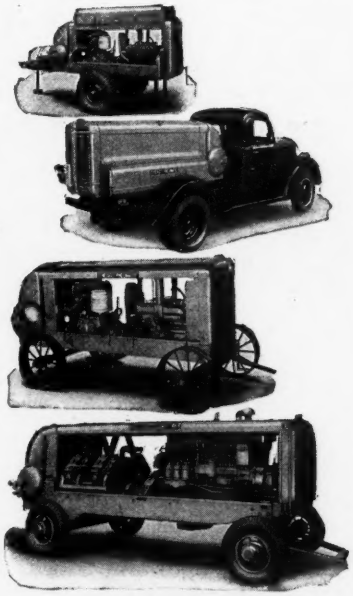
The coal is burned on inclined reciprocating grates which gradually move the burning fuel from the retort toward the ash pit. Type CN and CW stokers have the retort in the center of the furnace with an ash pit on each side, while type SN and SW have the retort installed at one side of the furnace with a single ash pit. Air for combustion is supplied by a forced-draft fan through air ports in the grate bars which are graduated so that the coal is burned at a uniform rate and finally consumed just before it spills into the ash pit.

Ash is readily shoveled or hoed from pits through ash doors in the boiler front.

Electric controls regulate the stoker in accordance with the load requirements.

Portable Compressors

New streamlined, two staged, air-cooled, portable compressors have been recently announced by the Chicago Pneumatic Tool Co., Chicago, Ill.



Many new types and sizes have been added to their line of equipment, among which is the new 500 cu. ft. portable compressor, furnished with all the latest C.P. features and powered by a 1000 r.p.m. 132 hp. caterpillar Diesel engine.

New Block and Pipe Insulation

A NEW 1500-DEG. insulating material called L-W Superex has recently been introduced by Johns-Manville. Furnished in both block and pipe covering form, this new material was developed by the J-M Research Laboratories and represents a marked improvement in conductivity and strength for an insulation in the service temperature range above 600 deg. F., according to the company's announcement.

L-W Superex is offered for use generally in stationary and marine power plant equipment and piping, the blocks being suitable for use in industrial furnaces, ovens, kilns, roasters regenerators, high temperature mains, flues, and stacks, where the insulation will be subjected to temperatures between 600 and 1500 deg. F. The sectional form is intended for piping and headers within the same temperature range.

This new insulation is of the moulded diatomaceous silica type, but it is exceptionally light in weight for a high temperature material, weighing only 20 lb. per cu. ft. The blocks are furnished 3, 6, 9 and 12 in. wide in standard lengths of 18 and 36 in. and in thicknesses from 1 to 4 in. Curved blocks are also available. The pipe insulation is supplied, to fit standard pipe sizes, in sections or segments 3 ft. long and up to 2½ in. thick. L-W Superex is marked with green ends to distinguish it from 85 per cent Magnesia and H-T (1900 deg.) Superex.

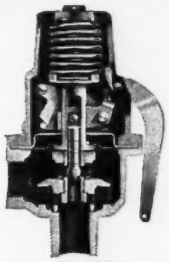
Silica Removal

The presence of silica in water used for boiler feed purposes, especially in the case of modern high pressure, high temperature installations, is the most serious problem confronting power plant operators today, for silica deposits cause boiler tubes to fail quickly, seriously reduce turbine output and, when once allowed to form, are extremely difficult to remove from boilers and other power equipment.

Betz Laboratories, of W. H. & L. D. Betz, Philadelphia, Pa., recognizing the importance of the silica problem, conducted extensive research, both in the laboratory and in industrial plants, which resulted in the development of the "Adsorption Process" for silica removal. This process which utilizes Remosil (a specially-prepared magnesium oxide), reduces soluble silica in any natural water to a fractional part per million while actually reducing rather than increasing the total solids in the water. Removal is effected in the hot process softeners. No expensive additional equipment is required. The "Adsorption Process" makes unnecessary the use of other coagulants, in softening operations. It causes no increase in the requirements of lime and soda ash, but rather it affects lower hardness and alkalinity of softened water than would otherwise be possible.

Safety Valve

MCDONNELL & MILLER, Wrigley Bldg., Chicago, Ill., has announced a new type of relief valve for hot water boilers. The new valve is known as the No. 29 Safety Valve and is named for its relief point of 29 lb. The design departs sharply from usual construction in that the valve is designed to snap open to its full orifice capacity at the precise moment the relief point is reached. It then stays open, discharging its full capacity until the boiler pressure is reduced to 22 lb. at which



No. 29

time it snaps to an instantaneous closure.

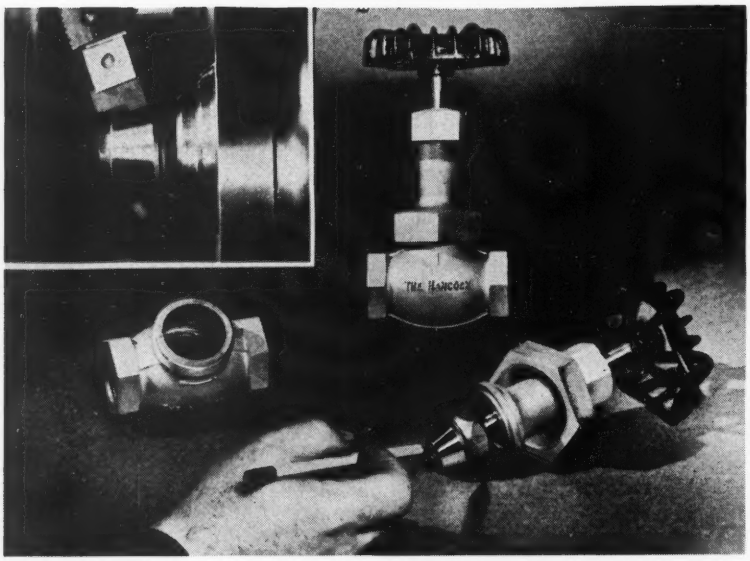
The illustration shows the cam-and-roller construction which carries out the snap action idea. When the pressure acting on the bellows reaches 29 lb., the tip of the cam slips past the roller, permitting a lever to trip the valve wide open, passing the full discharge capacity of the orifice.

New Ashcroft Trademark

ASHCROFT, makers of quality pressure gauges since 1850, announce a new trade mark to appear on all Ashcroft Gauges in the future. The shield outline, so

familiar to Ashcroft Gauge users is retained. However, the date (1850) when Ashcroft made the first gauges in this country, is now shown on the shield, together with the letters "U.S.A." The name "Ashcroft" in white across the center makes it a most prominent trade mark.

In announcing their new trade mark, Ashcroft call attention to the complete Gauge catalog which will be furnished to anyone interested in writing the Ashcroft Gauge Division, Manning, Maxwell & Moore, Inc., Bridgeport, Connecticut.



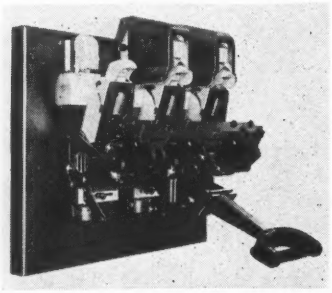
Superfinish For Hancock Valves

THE HANCOCK VALVE Division of Manning, Maxwell & Moore, Inc., Bridgeport, Conn., announces a new method of finishing Hancock Valves. Through the use of the development known as "superfinishing" the makers claim, the life of valve seats and discs in Hancock "500 Brinell" valves is increased twelvefold. Superfinishing produces a highly polished wearing surface by "howing" (actually rubbing and scrubbing with abrasives) which eliminates almost the last trace of friction. In tests, on valve testing machines, the superfinished valve seats and discs outacted 12 times the same seats and discs that had not been superfinished.

Special Superfinish Machines have been developed to finish the valves. Close-up of one such machine applying Superfinish to a valve disc is shown in the insert at the upper left of this picture. The makers say that every Hancock "500 Brinell" Valve is now being equipped with Superfinished seats and discs at no increase in price.

Circuit Breaker

THE TYPE LG circuit breaker, illustrated, is an improved design recently developed by the I-T-E Circuit Breaker Co. of Philadelphia, Pa. This breaker was designed for heavy duty service in which the number of operations are relatively few and where high interrupting capacity is needed without great operating speed. It is most suitable for use as a main breaker, a bus tie or exceptionally larger feeder breaker. In construction it conforms to the traditional design which the I-T-E Circuit Breaker Co. has developed through



many years of manufacture. Each pole consists of a main current carrying laminated bridge protected by secondary and arcing contacts. The LG circuit breaker is designed for operation on alternating current up to and including 600 v. and direct current up to and including 750 v. They are made in ranges in continuous capacity from 2000 to 6000 amp. ac. and from 2000 to 10,000 amp. dc. The standard range of tripping adjustment is 100 to 200 percent of the continuous ampere rating.

Plastic Tubing

Extruded plastic tubing with high heat resistance is announced by the Irvington Varnish & Insulator Company, 24 Argyle Terrace, Irvington, N. J. The new tubing is known as IRV-O-LITE XTE-100. This tubing maintains all its characteristics at a continuous temperature of 176 deg. F. and ideal for electrical insulation purposes. It has a dielectric strength when dry of 750 v. per mil and of 400 v. per mil after 24 hours soaking in water. It is extremely flexible, smooth inside as well as outside, has a tensile strength of 2000 lb. per sq. in., with high resistance to tearing and abrasion. It is unaffected by petroleum solvents, is not attacked by a 10 per cent solution of sulphuric acid, and resists most acids and alkalis in concentrations up to 30 per cent by weight.

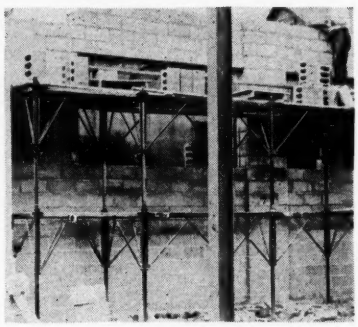
It does not support combustion, will not lose form up to 240 deg. F. Immersion in transformer oil at 220 deg. F. for 48 hr. produces only a slight swelling at the exposed ends of the tubing and has negligible effect on its flexibility. This tubing has also been used for non-electrical purposes, such as for windshield wipers, replacing copper tubing on combustion control apparatus and similar equipment where flexibility, long-life, resistance to heat and chemicals, and high tensile strength are important.

Steel Scaffold

Safety steel scaffolds, of new design for use by contractors, electricians, and maintenance departments, has recently been placed on the market by Mechanical Handling Systems, Inc., 4600 Nancy Ave., Detroit, under the trade name, Quik-Set Safety Scaffold.

The scaffold consists of square-section tubular steel brace and corner post units, of extremely rigid construction with electrically welded parts, so designed that the scaffold may be erected quickly: and the unique design of the various units permits erection in straight line, in corners, around rectangular or circular constructions, either inside or outside. Bridging over obstructions is easily accomplished with simple truss units.

Also available as steel floor sections which may be placed at any point in the scaffold; detachable ladders, adjustment posts for erection on uneven surfaces; brackets for catwalks and for holding



material; casters for use on interior work such as decorating, cleaning, electrical work, etc.; and a simple, safe skip-hoist for lifting materials to the proper level.

Quik-Set Scaffold may be leased or purchased outright.

New Automatic Timers

A NEW SERIES of 128 models of Interval Timers and Time Delay Relays has just been announced. They are powered by slow-speed, self-starting synchronous motors, and equipped with fast-acting silver contact micro-switches. These all-electric controls are designed for the many types of electrical equip-

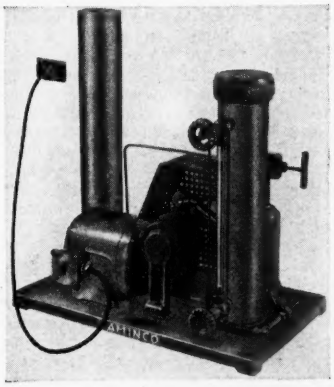
ment which must be accurately timed in split seconds, seconds, minutes or hours.

Manual or automatic reset models for built-in flush panel mounting, enclosed surface mounting or wall mounting—manufactured by Paragon Electric Co., 37 West Van Buren Street, Chicago, Ill.

New Hydraulic Booster Pump

A NEW MOTOR-DRIVEN hydraulic pump capable of developing pressures up to 6000 lb. per sq. in. is announced by the American Instrument Company, Silver Spring, Maryland.

It is especially applicable for use in creating high test pressures for catalytic hydrogenation work, for determining the bursting strengths of cylinders, spheres, etc., for operating high-pressure and hydraulic intensifiers, and for determining the effects of high pressures and their sudden release on various materials.



It consists essentially of a geared-head motor (for operation on 115 or 230 v. a.c. or d.c.), reservoir and compression chamber, mounted on a substantial cast iron base. Theoretical displacement per hour, 553 cu. in. Working volume of the reservoir, 1300 ml.; actual volume 3000 ml. Working and actual volumes of the compression chamber, 1300 ml. Tested to 9000 lb. per sq. in.

Hook-On Volt-Ammeter

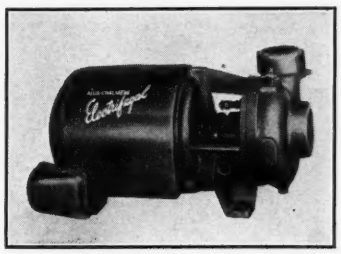
A VERSATILE, portable instrument, the Type AK-1 hook-on volt-ammeter, for measuring alternating current and voltage has been introduced by the General Electric Co. With it, alternating current can be read instantaneously on both insulated and noninsulated conductors simply by hooking the instrument around the line. For voltage readings, it is necessary only to connect two leads furnished with the instrument and then flip the thumb-

manipulated selector switch to the desired voltage position on the scale.

Designed for use on conductors of 2-inch maximum diameter, the new volt-ammeter is small enough to get into tight places, light enough to be hung from a lineman's belt, and sufficiently accurate for a great variety of measuring jobs. Weighing only 3½ lb., it is designed for easy, one-hand operation. Four current ranges, 0-15/60/150/600 amp., and two voltage ranges, 0-150/600 v. are available at the setting of a convenient six-position snap switch. Its accuracy is within 3 per cent.

New Electrifugal Pump

ALLIS-CHALMERS MFG. CO., Milwaukee, Wisconsin announces its new "Electrifugal" pump which is an all-in-one centrifugal pump especially designed as a complete pump and motor unit on one shaft and one housing. Instead of using standard motors having special end housings and shaft extensions, the "Electrifugal" pumping unit has a special motor with a one piece cast iron motor yoke and pump bracket. The feet are cast integral with the housing and bracket and extend under the entire unit instead of under the motor only.



The special motor design, with copper bearing steel cover, meets NEMA specifications for splash proof motors. Totally enclosed, fan cooled motors and explosion proof motors are also available in the "Electrifugal" type.

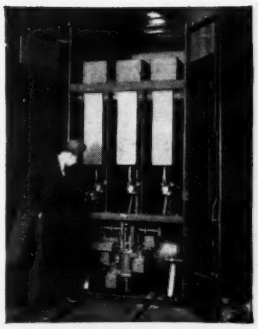
In splash proof construction the "Electrifugal" pump is now available in sizes from 1 hp. to 10 hp. inclusive at 3500 r.p.m. and from ¾ hp. to 7½ hp. inclusive at 1750 r.p.m. for heads up to 160 ft. Larger sizes of this type are in the process of design.

Compressed-Air Circuit Breaker

A NEW COMPRESSED-AIR circuit breaker, the type CA, for indoor service on 15,000-v. circuits has just been announced by the Westinghouse Electric and Mfg. Co. Designed for interrupting capacities as high as 2,500,000 kv-a., the new breaker interrupts arcs on the "cross blast" principle; that is, the arc is drawn between contacts which open in a line perpendicular to insulating splitter plates. The compressed-air stream is blown at right angles to the arc and elongates it between these plates.

A muffler placed at the end of the arc chute serves to eliminate residual flame and to reduce noise. It has a large cross section, so that the gas velocity is low and cooling is facilitated. The circuit breakers are equipped with air storage tanks. Pressure in these tanks is 150 lb. per sq. in., and drops about 20 lb. per sq. in. for each close-open operation.

Safety features of the air supply system include cut-off valves that automatically prevent a discharge of air from the system to a faulty breaker,



or from breaker tanks to a leaky system, and alarm valves which warn of leakage in either breakers or supply systems.

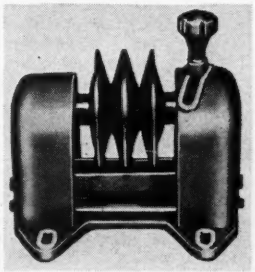
Oil-Resisting Caulking Compound

To meet the need for an oil-resisting electrical caulking material for transformer and oil switch bushings and covers, the J-M Research Laboratories have developed a new, permanent.y plastic substance called Petroseal, a compound that is equally adaptable to any electrical apparatus employing transil oil according to an announcement recently issued by Johns-Manville, New York, N. Y.

Petroseal is a non-hardening, adhesive plastic compound which will not slump or flow, nor dry out or check, remains easily workable over a wide range of temperature, adheres readily to any clean, dust-free surface, yet can be easily removed and salvaged. The material has good dielectric strength and is not injurious to workers' hands. It weighs approximately 100 lb. per cu. ft., and it is furnished in 1 and 5-lb. pugs, cartons of 30 and 12 plugs, respectively.

Variable Speed Transmission

A NEW V belt variable speed transmission, known as the All-Speed, is being introduced to industry by the Standard Transmission Equipment Co., Los Angeles, Cal. The speed selector operates on the variable pulley principle, and consists of two interlocking pulleys mounted on a common shaft. The selected speed is



maintained by means of a lock nut on the control quadrant, and the oblique slot which guides the spindle. Special impregnated bronze bearings are used with forced lubrication provided. The All-Speed, made in three sizes for ⅜ in. A and B belts, and in speed ranges up to 12-1, combines attractive design, durable construction, wide speed range, efficient and proven principle of operation.

News from the Field

Sterling Pump Acquires Roots-Connersville Pump Division

STERLING PUMP CORP., Hamilton, O., manufacturers of deep well turbine pumps, vertical centrifugal pumps for sewage and industrial purposes, and a complete line of hydro-jet pumps, has acquired the Turbine Pump Division of the Roots-Connersville Blower Corp. of Connersville, Indiana.

Roots-Connersville horizontal turbine pumps are generally used for water systems, industrial purposes and condensate work for boiler feed waters, and, according to Henry J. McKenzie, President of the Sterling Pump Corp., "the acquisition of this line places Sterling in a strong position for the furnishing of any type of pumping equipment."

A transfer of inventory has already been made from Connersville, Indiana, to Hamilton, Ohio, according to Mr. McKenzie, and all former Roots-Connersville installations will now be serviced, if and when necessary, by an enlarged staff of Sterling engineers available from coast to coast.

Max Rotter

Max Rotter, since 1912 with the Busch-Sulzer Bros.-Diesel Engine Co., St. Louis, as chief engineer and later as vice-president in charge of engineering, supervising the development of stationary, marine and submarine type Diesel engines, passed away on October 6 at St. Louis, Mo. He was 73 and death was due to a sudden acute attack of heart trouble.

His engineering career began in England in 1883 where for 8 yr. he specialized in power machinery, steam engines and hydraulic machinery, including three years with Maxim Nordenfelt Co. (Hiram S. Maxim) in experimental work, including steam power plant for Maxim's airplane.

He came to the United States in 1892, beginning work with the Walker Mfg. Co. of Cleveland, O., going to Fraser & Chalmers, Chicago, Ill., as mechanical engineer in 1894, and after the merger in 1902, became special engineer to the board of directors of Allis-Chalmers. His duties included investigating heavy machinery developments in Europe, embracing Parsons steam turbines, large blast furnace gas engines, high speed steam engines and Diesel engines.

He was transferred in 1904 to the Milwaukee office of Allis-Chalmers, first as engineer in charge of steam turbines and gas engines and then as chief engineer of this department, until he left in 1912 to join the Busch-Sulzer organization.

During the last World War, under Mr. Rotter's direction, four sizes of original Busch-Sulzer design of submarine engines ranging from 300 to 2500 hp. were successfully developed under his direction. Due to his 28 yr. of uninterrupted Diesel engine experience, Mr. Rotter has long been known as the Dean of American Diesel engineering.

New Water Treatment Head

M. P. Robinson, proprietor of the Robinson Filter Co., has joined the organization of the Worthington Pump & Mach. Corp., to take charge of its new water purification division, announced as of October 1st. Prior to establishing his own water purification company in 1937, Mr. Robinson had for 17 yr. been eastern representative of the International Filter Co. of Chicago. He received his early technical training at Lewis Institute of Technology at Chicago and is a licensed professional engineer under authority of the State of New Jersey.

$9,500,000 Expansion for Westinghouse Turbine Plant

THE WESTINGHOUSE Steam Division Works, near Philadelphia, Pa., will expand present facilities at a cost of over $9,500,000, to assure on-time delivery of turbines for 45 fighting ships of the United States Navy, according to R. A. McCarty, manager. The Navy vessels include battleships, airplane carriers, cruisers and destroyers.

"Recent contracts which total over $64,500,000 have established a new record backlog of orders for our plant," Mr. McCarty said. "In addition to the Navy equipment, land turbines and ship propulsion apparatus for the merchant marine are included. This machinery will total about 5,000,000 horsepower, of which 3,000,000 will be used to drive the Navy ships.

"Payroll of the Steam Division Works has reached around $1,000,000 a month, a new high," Mr. McCarty said. "This amount is paid to 4000 employees, largest force employed since 1921 and 66 per cent more than were employed there a year ago."

The plant expansion program includes a three-story headquarters building, now under construction, which will be occupied in December. Additional manufacturing space will be provided and present facilities rearranged to permit top speed manufacture. Present rate of production will be increased by four times for some types of Naval equipment. Over $5,000,000 worth of machine tools and other manufacturing equipment are being installed as rapidly as they can be obtained.

National Defense Co-ordination

Co-ordination of the facilities of 248 manufacturing plants in York, Pa., and vicinity for government defense work has been worked out by William S. Shipley, chairman of the board, York Ice Mach. Corp. The company has at present upwards of $20,000,000.00 in defense orders, but under this plan the work has been split up among local industries without plant expansion or interference with regular commercial orders.

The plan includes a "pooling" of all the manufacturing machinery in York County under the supervision of the York Manufacturers Association. An information file of available machinery enables American or British government officials to determine in a few minutes if the city of York can handle a contract for them.

Officers of the York Manufacturers' Association defense program committee responsible for the smooth operation of this community business plan are, in addition to the chairman, William S. Shipley, and association secretary, Robert E. Gephart: W. J. Fisher, vice pres. and gen. mgr., A. B. Farquhar Co.; R. P. Turner, vice pres., New York Wire Cloth Co.; and Warren C. Bulette, pres., Brandt-Warner Mfg. Co.

Deepwater Power Company to Expand Plant

The Deepwater Light & Power Co., with steam electric generating station at Deepwater Point, vicinity of Penns Grove, N. J., operated and controlled jointly by the Atlantic City Electric Co., Atlantic City, N. J., and the Philadelphia Electric Co. Philadelphia, Pa., has approved plans for new addition to station and installation of a new 20,000-kw. turbine generating unit. Work on project will begin soon and will require about 15 months for completion. A generator of capacity noted will be furnished by the General Electric Co., while a high pressure boiler unit, with capacity of 550,000 lb. of steam per hour will be supplied by Babcock & Wilcox Co. Awards for various station equipment are scheduled to be made at early date. The entire development is reported to cost approximately $3,500,000, of which close to $500,000 will be used for building and auxiliary construction and remainder for equipment. A considerable part of the new capacity will be used by E .I. duPont deNemours & Co., Inc., at its Deepwater chemical plant, which secures its power requirements from the Deepwater station.

Yadkin River Development Resumed

AS A RESULT of a favorable court decision, the P.W.A. announced that work will be resumed on the Yadkin River Hydro-electric development. Construction was suspended June 30, 1939, as a result of an injunction.

The City of High Point has instructed its engineers to proceed immediately with the resumption of work and Kenneth Markwell, Project Engineer on the Santee-Cooper project in South Carolina, has been named as P.W.A. representative. The estimated cost of the project is approximately 6½ million dollars. On the Yadkin River near Winston-Salem, N. C., the project consists of: an earth dam with a maximum height of 85 ft.; a concrete spillway and power house built into the dam, the latter housing three 7000 kw. units; and two 30 mi., single circuit, wood pole transmission lines which will carry the power to High Point, where it will be distributed through approximately 10 mi. of additional distribution lines.

In addition to power generation, the dam will provide flood control and stream regulation for hydro plants farther down stream engaged in the production of aluminum. The dam will impound 460,000 ac. ft. covering an area of approximately 15 000 ac. ft. Work on the project was originally started December 29, 1938.

Shipyard Expansion to Require Extensive Power Equipment

With the Navy Department, Washington, D. C., providing a gross fund of over $76,000,000 to a number of shipbuilding companies in different parts of the country for expansion in yards and facilities, a heavy demand for power equipment is imminent, covering both electric and steam facilities. The requirements will include motor-generator sets, heavy duty motors and controls,. transformers and accessories, regulators, duct lines, complete power substation apparatus, switchgear and allied electrical equipment; similarly, there will be numerous calls for boilers, pumps and complete steam power station installations. The appropriations now authorized are as follows, the coöperation of the Federal Government being for the purpose of providing facilities at earliest possible date for the construction of naval vessels now required for the National Defense program: the funds noted cover estimated costs of shipways, shops and miscellaneous buildings, and machinery and equipment of all character:

Bethlehem Steel Co., Shipbuilding Division, Bethlehem, Pa.: For Risdon-Union plant, San Francisco, Calif., $10,013,000; for San Pedro yard, Los Angeles, Calif., $2,756,000; for Fore River, Mass., plant, $13,427,500; for Staten Island, New York, plant, $2,-706 000.

Newport News Shipbuilding & Drydock Co., Newport News, Va., $14,000,-000.

New York Shipbuilding Corporation, Camden, N. J., $10,500,000.

Gulf Shipbuilding Corporation, Chickasaw, Ala., $2,500,000.

Bath Iron Works Corporation, Bath, Me., $1,600,000.

Federal Shipbuilding & Drydock Co., Kearny, N. J., $3,500,000.

Electric Boat Co., Groton, Conn., $2,750,000.

Los Angeles Shipbuilding & Drydock Corporation, Los Angeles, Calif., $450,-000.

Manitowoc Shipbuilding Corporation, Manitowoc, Wis., $1,000,000.

Consolidated Steel Corporation, Los Angeles, Calif., for new shipbuilding plant at Orange, Tex., $4,600,000.

Seattle-Tacoma Shipbuilding Co., Seattle, Wash., $6,502,000.

80,000-kw. for Chester

CHESTER STATION of the Philadelphia Electric Co. will have its rated capacity increased to 256,000 kw. by the addition of a 50,000 kw. high pressure unit now under construction and an 80,000 kw. low pressure unit for which contracts have recently been awarded.

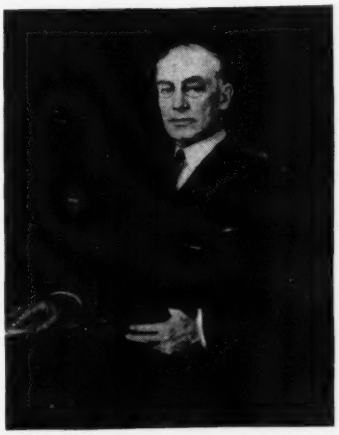
Construction work now under way at an estimated cost of $7,000,000 covers the 50,000 kw. turbo-generator and two high pressure boilers, operating at 1250 lb., ga., 925 deg. F. total temperature. The additional $4,600,000 will cover the new 80,000 kw. unit and auxiliary equipment which will be housed in an extension to the present turbine house. This will be approximately 50 ft. wide, 150 ft. long and 80 ft. high. The exhaust from the high pressure unit will pass through the low pressure unit.

In discussing the new installation, Horace P. Liversidge, president of the Philadelphia Electric Co., said: "On January 3 of this year the Philadelphia Electric Co. met the greatest demand in its history—910,000 kw. This peak commanded only 72 per cent of our available capacity, leaving a balance of 28 per cent untouched.

"Not content with this surplus, and following our policy of long term planning, we have under construction additions to Chester Station and have purchased ground in South Philadelphia for a new generating station eventually to be erected."

H. H. Timken, Sr., Dead

H. H. TIMKEN, SR., chairman of the board of The Timken Roller Bearing Company, died Monday, October 14, in his home at Canton, Ohio. Although still active in the business which he founded with his father and brother, in 1898, his two sons, H. H. Timken, Jr., and W. Robert Timken in recent years have taken an active part in the management of the company.



Mr. Timken attended St. Louis, Mo., public schools and spent many of his vacation periods in his father's carriage works, where he observed first-hand the processes of manufacturing and had his first introduction to industrial efficiency. Upon his graduation from St. Louis high school, where he was an honor student, he enrolled in Washington University in St. Louis. He entered the University of California and was graduated from there with a law degree. Admitted to the bar in California, he immediately began the practice of law in San Diego.

When his father re-entered the carriage and wagon-making field in St. Louis, he gave up law and joined him in the business.

When the father retired and left his two sons, Henry H. and William R. Timken to manage the carriage business, the young manufacturers realized that it would be only a matter of time until motor-powered carriages would replace the slower, horse-drawn carriages which the Timken organization was manufacturing. Anticipating the transition and realizing that they were located too far from their source of supply and the potential automobile market, they moved the company to Canton, Ohio. Ground was broken for the new plant in 1901 and production was started with a force of less than fifteen men in a two-story factory building shortly after January 1, 1902.

Mr. Timken became active head of the plant. With the company firmly launched in the automotive trade, he set up a sales staff and directed his attention to another important phase of the business—the development of new steel alloys.

As the Timken factory expanded, Mr. Timken took a less active part in the factory management and devoted more of his time to supervision of the entire plant. He kept a close check on every department—production, research, engineering, sales, and office. His goal became "Efficiency." This had been drilled into him by his father, emphasized in his legal training, and had come to have a very practical meaning in the process of manufacturing.

Mr. Timken was a philanthropist and benefactor to many and varied charitable institutions and welfare agencies. Most recent of his gifts is the new Canton Timken Vocational High School, built and furnished with the most modern equipment.

Survivors are Mrs. Timken; three sons, Henry H., Jr., W. Robert, and John; a brother, William R. Timken; a sister, Mrs. Cora B. Burnett, and two grandchildren.

Diesel Engineers Elect Officers

THE DIESEL Engineers International Association, Executive Offices 576 Newark Ave., Jersey City, N. J., have elected the following officers for the ensuing terms: Fred C. Congdon, president; Dennis A. McCarthy, first vice-president; Alfred Bohrer Krest, second vice-president; Julius Rosbloom, general sec.-treas. All of these officers hold a chief engineer's unlimited license.

Members elected on the National Technical Advisory Board are as follows: M. J. Dowd, ch. engr. and gen. supt., Imperial Irrigation Dist., Imperial, Cal.; F. K. Vance, supt. and ch. engr., Water & Electric Dept., city of Neodesha, Kan.; Clint Voorhees, supt. and ch. engr., Public Works, City of Dowagiac, Mich.; W. E. Ralls, supt. and ch. engr., Municipal Utilities, City of Trenton, Mo.; Thomas Moore, plant supt., Shenandoah Valley Electric Coop., Dayton, Va.; R. E. Doonan, ch. engr. and supt., Municipal Diesel Utilities, City of Waverly, Ia.; Elmer Davenport, ch. engr., Diesel Power System, McMinnville, Ore.; Bruce B. Watts, ch. engr. and supt., Municipal Diesel Utilities, City of Corning, Ia.; Roy E. Boling, ch. engr. and supt., Diesel Light & Power System, City of Pleasant Hill, Mo.; W. J. Dettman, ch. engr., Diesel Power Plant, City of Rochelle, Ill.; G. J. Woodhouse, ch. engr. and supt., Municipal Utilities, City of Harlan, Ia.; and D. R. Calhoun, Mgr. Ind. Div., Philadelphia, Pa.

Dr. Frank Conrad 50 Yr. With Westinghouse

DR. FRANK CONRAD, who began his career in science as a bench-hand with the Westinghouse Electric & Mfg. Co., Pittsburgh, Pa., and became internationally known as "the father of radio broadcasting," has completed 50 years of achievement which brought him to his present position as assistant chief engineer of the company. Dr. R. E. Hellmund, chief engineer, presented to his colleague a diamond-studded gold lapel emblem, token of the company's recognition of Dr. Conrad's half-century of

service. The award was presented within a month of the twentieth anniversary of the first regularly scheduled radio broadcast, for which he was responsible.

Born in Pittsburgh, Dr. Conrad was too anxious to learn about machines to continue his formal education beyond the seventh grade in the old Sterrett grammar school. At the age of sixteen, he went to work in October, 1890, as a bench-hand in the original Westinghouse plant in Garrison Alley, Pittsburgh. Because of his unusual grasp of mechanical problems he was soon transferred to the testing department.

Since contributing the round type electric meter now in universal use, Dr. Conrad has developed pantagraph trolleys for electric trains, electric clocks for homes, several applications of electricity for automobile starting, lighting and ignition. He holds more than 200 patents, but he is best known for his pioneer work on radio broadcasting and short wave transmission.

Dr. Frank Conrad receiving a diamond-studded gold emblem in recognition of 50 years' service with the Westinghouse Electric & Mfg. Co. from Dr. R. E. Hellmund, Chief Engineer of Westinghouse

During the World War the government drafted Dr. Conrad and his inventive talents. He responded by developing the first practical aircraft radio transmitter. After the war, Dr. Conrad began using phonograph records in his experimental radio broadcast. By 1919 he was surprised by the mounting number of letters and telephone messages pouring in.

Then, one day a Pittsburgh department store published an advertisement for radio sets which would enable the owners to hear the Conrad broadcasts. The advertisement gave the engineer an idea: Why not broadcast news, music and entertainment? Dr. Conrad's associates at Westinghouse thought it could be done, and an intercompany radio station at the East Pittsburgh Westinghouse works was converted into a general broadcasting transmitter. Application was made to Federal radio authorities for permission to use this station for commercial broadcasting, and it was assigned the letters KDKA. On election night, November 2, 1920, just 20 years ago, KDKA put on the air the world's first regularly scheduled radio broadcast—announcing the returns in the Harding-Cox election contest.

In 1904 Dr. Conrad had been appointed general engineer, and for many years served as assistant to the vice president in charge of engineering. Following the pioneer radio broadcast, he was appointed assistant chief engineer, in 1921.

Dr. Conrad received the honorary degree of Doctor of Science from the University of Pittsburgh in 1928. In 1936 he was awarded the Morris Liebman prize by the Institute of Radio Engineers; the Edison Medal of the American Institute of Electrical Engineers in 1931; the John Scott Medal of the City of Philadelphia in 1933; the Lamme Medal of the A.I.E.E. in 1936.

Atkin Heads Ferguson Co. Engineering Department

CHARLES G. ATKIN became associated with The H. K. Ferguson Co. in Cleveland in 1930, as contract engineer, was later made Vice President and contract manager, and is now Vice President in charge of all engineering. He was formerly connected with Lockwood Greene Engineers, Inc., as supervising engineer in their Chicago office, and later became district manager with headquarters in Cleveland.

Mr. Atkin served in World War I, 47th Artillery C. A. C., with the rank of Major. He is a member of the Cleveland Club and Cleveland Chamber of Commerce.

Thomas F. Rataiczak, chief engineer of the Hobart Mfg. Co., died Oct. 5 at his home in Troy, O. He was born in Stryker, O., in 1882, and graduated from Ohio State University in 1908. After some time in the West he returned to Troy and accepted a position in the engineering department of the Hobart Company. In 1928 he was appointed chief engineer of the company and continued in that position until the time of his death. In addition to his company connections he was very active in civic affairs and took an active part in national engineering as a member of the Dayton Engineer's Club, A.S.M.E., Sigma Xi and Tau Beta Pi, national honorary and engineering societies respectively.

Morrison Mills, eastern district manager of the construction equipment division of Chain Belt Co. of Milwaukee, died suddenly September 25 in Philadelphia where he made his home. He was born in Calumet, Mich., 37 yr. ago and graduated from Harvard University with the class of 1925. From 1931 to 1937 he was service manager of the construction equipment division of the company and Eastern District Manager since that time.

Bureau of Reclamation

WALKER R. YOUNG, supervising engineer of the Central Valley Reclamation project of California, was appointed assistant chief engineer of the Bureau of Reclamation on Oct. 16. His new post will be in Denver, Colo., the field headquarters of the Bureau. Mr. Young was born in Butler, Ind, in 1885 and graduated from the University of Idaho with a degree of B. S. in engineering in 1908. He worked as chainman, rodman, surveyor and topographer for the Great Northern Railway and other private concerns until 1911, when he received an appointment as assistant engineer in the Bureau and participated in the design of Arrowrock Dam in Idaho.

By 1916 he headed the mechanical and dam division of the designing department in the Chief Engineer's office in Denver. In 1921 he was placed in charge of field investigations leading to the adoption of the plan for the development of the Colorado River and he formulated the original designs and estimates for Boulder Dam.

In 1924 he was detailed to an investigation of the salt water incursion from Sacramento Bay into the Sacramento and San Joaquin Rivers, and 2 yr. later was appointed construction engineer of the Kittitas Division of the Yakima Reclamation Project in Washington. In 1931 he was designated construction engineer in charge of the building of Boulder Dam and held this position throughout the construction period, being placed in charge of the Central Valley Project in California in 1935.

G. Sinding Larsen

ACCORDING to the announcement of the Pittsburgh Piping and Equipment Co., Pittsburgh, Pa., G. Sinding Larsen has been elected a director of the company. Joining the firm in 1924, Mr. Larsen was appointed chief engineer in 1938.

G. Sinding Larsen

Allen-Sherman-Hoff Co. of Philadelphia, Pa., recently opened its own office in New York City at 271 Madison Ave. (Room 1006), with B. C. Berry and P. D. Oesterle in charge.

Construction of High Point, N. C. Electric Plant to Resume

THE CITY COUNCIL, High Point, N.C., is arranging for the early resumption of construction on new municipal hydroelectric generating station on the Yadkin River, vicinity of Clemmons, N. C., approximately 26 miles from city. Initial work on project was begun early in 1939, following consummation of Federal financing, and suspended a few months later. Final plans have now been determined and it is proposed to push the development to completion in 1941. It will com-

prise a power dam about 85 ft. high, concrete spillway, and hydroelectric generating station with initial capacity of 21,000-kw., divided into three 7000-kw. hydraulic turbine units, switchyard and miscellaneous structures. A transmission line, composed of two single circuits, will be built to the city, where a power substation will be constructed near the municipal limits. Entire project is estimated to cost close to $6,500,000; financing has been previously arranged through a Federal grant of $2,921,600 and Federal loan of $3,571,000. Murray & Flood, Inc., 369 Lexington Avenue, New York, N. Y., consulting engineer, has prepared plans for the plant.

Plattsburg, N. Y. to Acquire Distribution Lines for Municipal Plant

THE CITY COUNCIL, Plattsburg, N. Y., has work nearing completion on a new municipal power plant, in progress for a number of months past, and the station is scheduled to be ready for service this fall. The plant will represent an investment of about $370,000 and will use Diesel engine-driven generating units, with capacity for all immediate municipal requirements. While bids were asked last April for a municipal distribution system, negotiations meantime have been under way with the New York State Gas & Electric Co., serving the city, for the purchase of its local lines and distribution facilities, and agreement has now been reached to acquire such property at approximately $200,000, bringing the municipal power development to a total cost of about $570,000, complete. The agreement with the utility company is subject to final approval by the Federal Power Commission, Securities and Exchange Commission, and other agencies, and it is expected that ultimate consumation will be effective late in October, when the municipal plant will be available for taking over the load. The station will serve about 5,000 consumers in the Plattsburg area. It was designed and erected under the supervision of Burns & McDonnell Engineering Co., 107 West Linwood Boulevard, Kansas City, Mo., consulting engineer.

Consolidated Gas, Electric Light & Power Company to Expand Westport Station

CONSOLIDATED GAS, ELECTRIC LIGHT AND POWER CO., Lexington Building, Baltimore, Md., will make further extensions at Westport steam-electric generating station, where expansion has been in progress for a number of months past. Immediate work includes the installation of a 25,000-kw. topping unit of General Electric Co. type and auxiliary equipment, scheduled for completion at early date. The new program includes the installation of a 52,000-kw. turbine-generating unit, for which contract similarly has been awarded to General Electric Co.; also, a high-pressure boiler and accessories, to be furnished by Babcock & Wilcox Co., New York, N. Y. The project is estimated to cost over $3,000,000, including extensions in transmission lines and power substation structures, and will be carried out during 1941.

Chicago Pneumatic Tool Co. announces the appointment of P. J. Christy as Manager of their Philadelphia, Pa. office, effective August 1, 1940. He succeeds A. M. Brown who has been transferred to Washington, D. C., as manager of the new branch recently opened there. The company also announces the appointment of C. A. Diehl as manager of the Houston, Texas, office.

The Babcock & Wilcox Tube Co., Beaver Falls, Pa., announces the appointment of MacFarlane Foundry and Honolulu Iron Works, S. A., located at Sagua La Grande, Cuba, as boiler tube distributor and agent for B. & W. Seamless Steel Tubular Products in Cuba. They carry a stock of B. & W. Seamless Boiler Tubes suitable for use by the railroads, sugar companies, and other industries in Cuba. They have business offices in Apartado No. 109, Edif. Gomez Mena, Habana, Cuba.

The H. K. Ferguson Co., Cleveland, O., has just been awarded a considerable amount of additional engineering and construction work by the Marmon-Herrington Co., Indianapolis, Ind.; one of the first plants to get into rush production for national defense purposes.

The additional facilities when completed will be: A new manufacturing building 90 by 480 ft.; extension to present manufacturing building 90 by 178 ft.; shipping building 60 by 300 ft.; service building 40 by 65 ft., additional floor to present office building, with fluorescent lighting and air conditioning throughout; boiler house, to furnish steam to the entire plant; and a test course for tanks and trucks, including water pits, trenches, and other obstructions which may be encountered in actual use.

Northern Equipment Co., Erie, Pa., announces the appointment of Neil H. Brown as district representative for Copes feed water regulators, differential valves, pump governors and allied equipment. Mr. Brown will make his headquarters at 1117 Liberty Life Bldg., 112 South Tryon St., Charlotte, N. C.

Florida Power & Light Company Plans $3,000,000 Expansion

FLORIDA POWER AND LIGHT CO., Miami, Fla., has plans under way for expansion and improvements in Lauderdale steam-electric generating station at Fort Lauderdale, Fla., designed to more than double present capacity. Work will include the erection of a new multi-story addition, with installation of turbine-generating unit, two high-pressure boilers and auxiliary equipment. Switch-yard structure will be enlarged and extensions made in transmission lines for inter-con-

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STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., required by the Acts of Congress of August 24, 1912, and March 3, 1933, of POWER PLANT ENGINEERING, published monthly at Chicago, Illinois, for October 1, 1940.

State of Illinois, } ss.
County of Cook, }

Before me, a Notary Public in and for the State and county aforesaid, personally appeared K. L. Rice, who, having been duly sworn according to law, deposes and says that he is the Business Manager of the Power Plant Engineering and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, as amended by the Act of March 3, 1933, embodied in section 537, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are:

Publisher, Technical Publishing Company, Chicago, Ill.
Editor, R. E. Turner, Chicago, Ill.
Managing Editor, None
Business Manager, K. L. Rice, Chicago, Ill.

2. That the owner is: (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding one per cent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a firm, company, or other unincorporaed concern, its name and address, as well as those of each individual member, must be given.)

Technical Publishing Co., Chicago, Ill.
Arthur L. Rice, Chicago, Ill.
Charles S. Clarke, Chicago, Ill.
Kingsley L. Rice, Chicago, Ill.
Ralph E. Turner, Chicago, Ill.
Andrew W. Kramer, Chicago, Ill.
John O. Aarvold, Chicago, Ill.
Otto Kaad, Chicago, Ill.
Walter Painter, Chicago, Ill.
Richard H. Morris, Chicago, Ill.
Edwin C. Prouty, Chicago, Ill.
Madge W. Rice, Wilmette, Ill.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: (If there are none, so state.)

There are none.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

5. That the average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the twelve months preceding the date shown above is .....
(This information is required from daily publications only.)

K. L. RICE,
Business Manager.

Sworn to and subscribed before me this 1st day of October, 1940.

JOHN O. AARVOLD.

(My commission expires March 20, 1944.)

nection with other power systems in Southern area. Entire project is estimated to cost close to $3,000,000 and is scheduled for completion in 1941.

Proposed Power and Flood Control Dams on White River to Cost $79,000,000

THE UNITED STATES ENGINEER OFFICE, War Department, Washington, D. C., has recommended the construction of two new dams on the White River in Arkansas and Missouri, following investigations and surveys. The proposed dams will be located at Bull Shoals, vicinity of Cotter, Ark., and Table Rock, near Branson, Mo., respectively, where sites have been determined, and will be used for flood control in the immediate areas and hydroelectric power development. The first noted dam will have a gross water storage capacity of 2,275,000 acre-feet, while the Table Rock dam will provide for a storage capacity of 1,685,000 acre-feet. It is proposed to build hydraulic generating plants at both dams with a combined rating of 185,000-kw. Entire project is estimtaed to cost approximately $79,000,000, with transmission lines, power substations and switching stations, and other operating facilities. The project has been submitted to Congress for approval.

$11,500,000 Expansion by G-E Turbine Dept.

GENERAL ELECTRIC is spending $11,500,000 in expanding present facilities for manufacturing propulsion equipments for the U. S. Navy, according to a recent announcement by Charles E. Wilson, president of the company.

The expansion program involves equipping an existing building at the company's Erie (Pa.) works with heavy machinery for the manufacture of large steam turbines required by destroyers and light cruisers, and enlarging two of its Lynn (Mass.) shops where reduction gears for the propulsion equipments are made.

The additional facilities obtained by this expenditure will release available capacity at Schenectady for the manufacture of the larger turbines for battleships, as well as those regularly manufactured for utility customers. At the present time, General Electric has an order or is building land and marine turbines totalling 6,000,000 hp., 3,000,000 hp. of which is for U. S. Navy ships.

Equipping the existing shop at Erie for manufacture of turbines will cost $8,500,000. Delivery of the first units from that point will be made toward the end of 1941.

The $3,000,000 expansion of the gear shop facilities at Lynn was started last spring, according to the announcement. Construction started then on the two new shop additions will nearly double G-E's facilities for manufacturing reduction gears when completed early next year.

The Universal Gear Corp., Indianapolis, Ind., announce the appointment of Lloyd B. Edwards and associates, as District Representatives for the Minneapolis territory in full charge of the company's sales activities in that area, with offices at 841 Lumber Exchange Building, Minneapolis, Minnesota.

W. F. Raber, President of the San Diego Consolidated Gas & Electric Co., announces that effective August 28th the name of the company has been shortened to the San Diego Gas & Electric Co. The change was entirely a matter of convenience and will not affect the status or operations of the company in any way.

Recently announced by the American K.A.T. Corporation, D. H. Skeen and Co. have been appointed exclusive sales agents in the Chicago territory for K.A.T.'s All-Colloidal water treatment.

T. H. Banfield, president of the Iron Fireman Mfg. Co., has announced that the company will devote part of its plant capacity in Portland to the manufacture of airplane parts. They will produce machine parts for the 512 Flying Fortress four-engined bombers ordered by the U. S. Army. Iron Fireman is also acting as a subcontractor for Boeing Aircraft Company.

V. B. Sanders, assistant to the vice president in charge of finance and accounting, Public Utility Eng'g. Service Corp., died Sept 23 in Evanston, Ill., after a long illness. He was associated with the Standard Gas & Electric Co. system since 1910, in Oklahoma City, Stillwater, Minn., Fargo, N. Dak. and Minneapolis office. In July of 1923, he came to Chicago and, since 1929, had been assistant to the vice president. He was 53 yr. old.

He is survived by his widow and son, Frank. and resided at 2762 Eastwood Avenue in Evanston.

Henry J. McKenzie, Executive Vice-President and General Manager of Sterling Pump Corp., Hamilton, O., manufacturers of deep-well turbine and centrifugal pumping units, has been appointed President of that corporation to succeed Maurice Rothschild, who will continue as a director.

Mr. McKenzie, who also retains his duties of General Manager in addition to those of President, has long been identified with and is an outstanding and well-known personality in the pump industry.

Chester H. Norton, purchasing agent at Allis-Chalmers Boston works, has been appointed Assistant General Manager of Purchases at Allis-Chalmers Mfg. Co. He has been transferred to the company's main offices in the West Allis Works at Milwaukee, Wis., where he will assist Mr. Fred E. Haker, general manager of purchases for the company.

Mr. Norton was graduated from the engineering school of Maine University in 1915. He served in the U. S. Navy as assistant Naval Constructor, Lieutenant Junior Grade, during the World War, after which he successively occupied positions of purchasing agent for several companies in the East. He was purchasing agent for the former Condit Electrical Mfg. Co. of Boston, when Allis-Chalmers acquired that plant in 1930.

H. W. Hauser, formerly with the company's purchasing department in Milwaukee, will succeed Mr. Norton as purchasing agent at Allis-Chalmers Boston Works.

Pittsburgh Coal Co., Pittsburgh, Pa., announces the election of J. B. Morrow as President. He succeeds J. D. A. Morrow who will continue to serve as a member of the board and the executive committee.

Announcement is made of the appointment of Kenneth S. Wyatt, cable engineer, to the staff of the Habirshaw Cable and Wire Division of the Phelps Dodge Copper Products Corporation of New York.

Mr. Wyatt, widely known in engineering circles here and abroad for his many technical papers, several of which were awarded prizes by engineering societies, formerly was technical director of the Enfield Cable Works Ltd. of London, England, and in recent years has been engaged in the development of the Hochstadter Compression Cable, having installed two systems for the Central Electricity Board of London, and others in Yorkshire and Hackney-Walthamstow, near London.

Prior to his work in England, Mr. Wyatt was associated with the Detroit Edison Company for nearly ten years, developing improvements in high voltage cable insulation, both through research, particularly the development of analytical methods for detecting deterioration and evaluating cable quality, and also through extensive committee work in the American Institute of Electrical Engineers, and in the Association of Edison Illuminating Companies.

Harvey Wilson, formerly in charge of the Philadelphia Sales Office of The Babcock & Wilcox Tube Co., has been transferred to New York and placed in charge of the company's New York Office territory as District Sales Manager. He will also have jurisdiction over the Philadelphia Sales Office, to which office R. M. Lackner has been transferred from the Detroit Sales Office. B. F. W. Seaburn, transferred from the District Sales Office at Beaver Falls, Pa., has been placed in charge of the Detroit Sales Office.

According to a recent announcement by T. H. Banfield, president of Iron Fireman Mfg. Co., stoker shipments during September were 31 per cent higher than any previous month and exceeded shipments for the entire year of 1938. In Portland, Ore., the company has purchased a second plant which will be operated in conjunction with the main plant there and other factories in Cleveland and Toronto.

Machine tools are already being installed and production in the new plant will begin by Jan. 1, 1941, on parts for the Boeing Aircraft Co. now filling national defense air contracts amounting to more than $130,000,000. Operation of both Portland plants to take care of the increasing stoker demand and the additional aircraft parts orders will be on a three-shift basis.

Announcement has just been made by the Roots-Connersville Blower Corp. of Connersville, Ind., that J. T. Sutliff is now in charge of the company's Chicago office which is located at 122 South Michigan Ave.

Mr. Sutliff, who succeeds the late Wm. Townsend, has been connected with Rotts-Connersville for many years, and prior to going to Chicago in 1935 he was located at the factory.

E. A. Coons, also a graduate engineer, has been placed in the Chicago office to assist Mr. Sutliff.

(Left) Actual photograph of a Gulf engineer consulting with the Chief Engineer of this large plant on a Periodic Consultation Service call.

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American industries and home owners bought more coal stokers in September than in any other month in history, according to preliminary data. The Iron Fireman Mfg. Co. of Portland and Cleveland reports shipment of 31.3 per cent more units than in its previous high month, and that more units were sold in the one month of September than in the entire year of 1929 is announced by President T. H. Banfield.

The Bogue Electric Co. has expanded its facilities at 80 Glover Avenue, Paterson, N. J. The company is now in a position to assure stock shipment on its extensive line of plating generators, special alternators, controls, panel boards, synchronous motors and plating equipment. The low voltage generator line has been extended to include 25,000 ampere machines at 6 v. and synchronous motors to 250 hp.

William B. Ramsdale, of the technical staff of Battelle Memorial Institute, Columbus, Ohio, has been named investigator of ignition temperatures of various coals and cokes. He is a graduate of Southwestern College and Syracuse University.

Cutler-Hammer, Inc., Milwaukee, Wis., announces the opening on October 1, 1940, of its new factory, warehouse and sales office at 711 Potrero Ave., San Francisco, California, a modern, one story structure with facilities for lubrication of Panel Boards, Switch Boards, Multi-Breakers, and special assemblies of motor control. Distribution is handled through four sales offices; Los Angeles, San Francisco, Portland and Seattle. The building also includes large warehouse space for stocking and handling the company's line of control apparatus, and the Pacific Coast sales headquarters with F. H. Oberschimdt as manager, who also supervises the Seattle, Wash., and Portland, Oregon, sales office.

R. S. Clingan has been recently appointed Chicago District Manager for Copperweld Steel Co., of Warren, Ohio. He is to handle the sale of Aristoloy alloy steels. For the past ten years Mr. Clingan has been connected with the Republic Steel Corp.

For the Engineer's Library

Recent bulletins and catalogs on power plant equipment listed for your convenience in securing specific information. Power Plant Engineering will be glad to procure for you any free literature that you desire.

Controls, Meters and Instruments

Controls—A 24 pp. catalog, No. 640, has recently been released, giving complete information on boiler feed and condensate recovery systems and their magnetrol liquid level controls. Schaub Engineering Co.

Steam Control.—Pressure reducing and desuperheating control of the air operated type is illustrated and explained in a new bulletin No. 107-A issued by Bailey Meter Co., Cleveland, O. The bulletin includes diagrammatic arrangements, installation photographs and detailed photos of individual control units. Chart records show the operation of typical Bailey pressure reducing and desuperheating systems. A partial list of installations includes pertinent data for each application listed.

Boiler Control—A new bulletin No. 108 entitled Bailey Boiler Control for Marine Service divides boiler control into the problems of combustion control, feedwater control and superheated steam temperature control. Detailed diagrams illustrating the arrangement and operation of the various control systems are shown together with illustrations of control units and installation photos showing their application aboard ship. Bailey Meter Co.

Instruments—A new 4 page circular describes the new Solu-Bridge solution tester and its application to the bottle washing industry. Industrial Instruments, Inc.

Instruments. A new 12-page illustrated catalog covering the "37" line of miniature panel instruments is announced by the Westinghouse Electric & Mfg. Co. These small instruments, approximately 4½ inches in diameter, and available in three mounting styles have a broad field of application; from industrial and radio test apparatus down to the gadget of the amateur experimenter.

Instruments—GEA 2645A, a 4-page bulletin illustrates and describes small panel instruments for equipment manufacturer. General Electric Co.

Liquid Level Meters. A new 8-page bulletin (Publ. 2990) covering six different styles of mechanical and electric operated liquid level meters has just been published by Cochrane Corp. Four electric operated types particularly designed for remote service, including float, differential pressure, and bourdon spiral systems, are included in the bulletin. The potentiometer type meter described on page three is a new design. The Selsyn circuit previously used in this electrically operated float type liquid level meter has been discontinued. This potentiometer circuit is the same as used with the Cochrane remote flow indicators. Application drawings and technical data are conveniently arranged in sections devoted to each of the various available instruments.

Portable Air Compressors. Bulletin 758 (4th edition) is a 28-page booklet describing the newly designed streamlined portable air compressors manufactured by the Chicago Pneumatic Tool Co. These two-stage air-cooled units have been made since 1934, but now they are offered in a modern streamlined design that harmonizes their appearance with their smooth performance. They are made in different sizes and with different mountings.

Gages—The new multi-point indicator and other Republic draft pressure instruments are described in a new 12 page bulletin just issued by the Republic Flow Meters Co. This is bulletin No. 801.

Valves, Gaskets and Unions

Valves—Circular 100, released by the Automatic Switch Co., New York, N. Y., illustrates and describes Solenoid valves for automatic and remote control of air, steam, liquids and gases.

Valves. A 240-pp. letter-size cloth-bound Kennedy catalog No. 63, is an exceptionally complete presentation of data on bronze and iron-body valves for low, standard, and higher pressures, standard bronze and malleable-iron screwed fittings, standard cast-iron flanged fittings and flanges, fire hydrants, and valve specialties. Additional features of the catalog are recommendations for the selection of valves and fittings, suggestions for operation, care and maintenance of valves, and much useful engineering data.

Copies can be obtained by writing The Kennedy Valve Mfg. Co., 1105 East Water Street, Elmira, N. Y., on company stationery.

Valves—A new bulletin describing the Hancock 500 Brinell superfinished valve was recently announced by the Hancock Valve Division of Manning, Maxwell & Moore, Inc.

Gaskets—The Goetze Gasket & Packing Co. Inc., New Brunswick, New Jersey, announces a new 64-page handbook and catalog on industrial gaskets. This new handbook, known as catalog No. 53, obsoletes all previous literature of the company. It contains advanced engineering data, developed in the Goetze Research Laboratory . . . shows many new and improved products . . . gives complete size and price information. Illustrated and concisely written it offers a valuable time-saving reference.

Unions—The Central Forging Co., Catawissa, Pa., announces Bulletin 8B, describing the Catawissa unions. Fully illustrated, these unions are said to expand and contract with the pipe, thus assuring tight joints. This 16 page catalog may be had upon request.

Stokers, Boilers and Fuels

Stokers. Bros Seyer-Spread stoker is the title of a new 10 pp. folder in color describing the construction, features of and typical installations of this stoker built in capacities of up to 4000 lb. of coal per hr. per unit. Wm. Bros. Boiler & Mfg. Co.

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are these mechanical wizards constantly checking metals for physical improvements.

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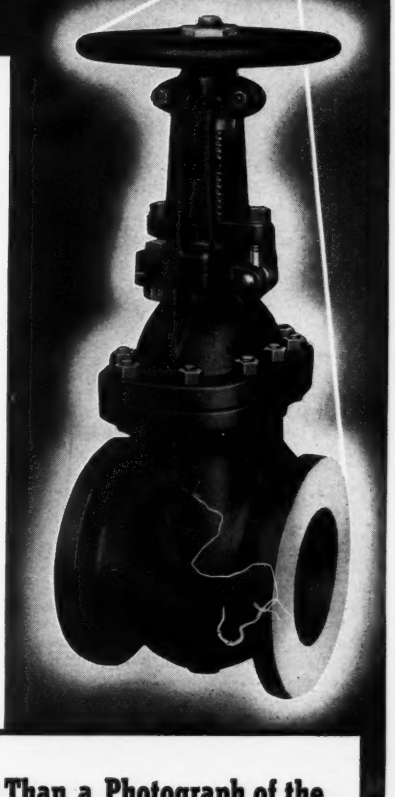

You Need More Than a Photograph of the Finished Product to See ALL of the Qualities that Make Powell Valves Uniquely Able to Better Serve the Power Engineer

THE WM. POWELL COMPANY
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POWELL VALVES

Boilers and Furnaces. A 4 pp. bulletin, recently released, describes 'Sairset, a high temperature bonding mortar for use in fire brick linings in boilers and furnaces. A. P. Green Fire Brick Co.

Oil Burning. Enco Fuel Oil burning pumping and heating systems is the title of a four pp. booklet published recently by The Engineer Co.

Oil Filters. The FerroFilter, a magnetic separator for the removal of iron and magnetized particles from lubricating oil is described in a new 4-page catalog, Number 15. S. G. Franz Co., Inc., 161 Grand St., New York.

Cut Fuel Oil Cost is the title of a new booklet describing the arrangement, installation, construction and operation of the Adams Photoelectric Combustion Control using the Robot-Eye or photoelectric cell. The control may be used either on a fuel oil or pulverized coal installation and is adaptable for use with manual, semi-automatic or fully automatic control. General Power Plant Corp.

Diesels

Diesel Engines—The Answer to Low Cost Power and Light, Bulletin No. 1000, and Industrial Engines, Bulletin No. 1001, are recent publications covering the construction, specifications, performance and application of the Atlas-Lanova Diesel engines, with cylinder sizes of 3⅛ in. bore, 3/34 in. stroke. The first covers six models of electric generating units ranging from 3 to 9 kw. with one or three cylinders rated at 5 and 15 hp. at 1800 r.p.m. The second covers industrial type engines in two models, one and three cylinder units rated at 5 and 15 hp. respectively at 1800 r.p.m. Atlas-Lanova Div., Atlas Imperial Diesel Engine Co.

Diesels. The new HD-7 Diesel Crawler Tractor is described in a new 24 page colored catalog. This new 54 hp. tractor utilizes the General Motor 2 cycle Diesel engine. Allis-Chalmers Mfg. Co., Milwaukee, Wis.

Belting

Belts—A new Drive Data Book for Condor Whipcord Endless Belts lists standard sizes of two styles of this endless flat belt which are carried in stock and are capable of handling drives from ¼ to 25 hp. More than 1500 drives of all types are available with these standard stock belts. The Manhattan Rubber Mfg. Division, of Raybestos-Manhattan, Inc.

Belting. Containing condensed information on its line of transmission belting, The B. F. Goodrich Co. has issued a new 4-page catalog section on the subject, which is available upon request to the manufacturer. Descriptions of belts in the Goodrich line, including "Highflex Jr.," "Drivesall," "Commander," "Rob Roy" and "Multicord" are presented, as well as those of Goodrich belt dressing and Plastikon stick dressing. Net weights of each belt per inch of width per 100 feet also are given, as is a table on stock sizes of transmission belting, including belt widths and number of plies.

V-Belt—B. F. Goodrich Co., Akron, O., has recently published a new 170 page V-Belt Data Book.

The book gives alphabetical listings of belt requirements for electric refrigerators, washing machines, water pumps, beer pumps, stokers and oil burners, gasoline pumps, wood-working machines, air compressors, power lawn mowers, buffing machines, floor sanding machines, garage and shop equipment, milking and slicing machines. Included are numerical group listings of belt sizes and dimensions for V and flat belts. Book is available upon request.

Circuit Breakers

Circuit Breaker—The I-T-E Circuit Breaker Co. has issued Catalog No. 1101 describing their newly improved Type L G Circuit Breaker. It gives information on the new arc quenchers, the new contacts and the new buffer mechanisms developed for this breaker. Dimensional data for the various sizes is given.

Oil Circuit Breaker. Allis-Chalmers Mfg. Co., Boston Works, has issued two new bulletins on quick clearing frame mounted high voltage oil circuit breakers for outdoor service. Bulletin B-6003 illustrates and describes the company's very large units available in standard ampere and interrupting capacity ratings from 15 kv. to 69 kv. Bulletin B-6093 covers small units in standard ratings from 15 kv. to 23 kv. Both of these bulletins are well illustrated and fully cover the distinctive features of design which include quick quench ruptors, high speed solenoid operator and accessible control cabinet.

Oil Circuit Breakers. A new 8-page illustrated folder (Descriptive data 33-560) which describes indoor oil circuit breakers designed especially for use in industrial plants and central stations, has just been announced by the Westinghouse Electric and Mfg. Co. These type F-100 breakers are available in sizes from 600 to 1200 amp. at 15,000 volts; 2000 amp. at 7500 volts; with interrupting capacities of 100,000 kv-a.

Recent improvements in the F-100 breakers formerly found only in breakers of much larger capacities, are pointed out and described. A section on application gives pointers on where and how this unit may be used. Features, such as condenser busings, trip-free control panel and others are described and a series of pictures illustrates the action of the "De-Ion" grids in extinguishing arcs during current interruptions.

Electrical ratings are listed, and data is given on weights, oil capacity, operating mechanisms, and dimensions. Sketches show dimensional clearance spaces required for breaker installation.

Circuit Breakers — Allis-Chalmers Mfg. Co., Boston Works, announces Bulletin B-6122 describing type OX-110 oil circuit breakers for moderate capacity applications on outdoor distribution service. It illustrates and describes this quick clearing (8 cycle) breaker of non-oil-throwing design, framework mounted, rated 600 amperes, 15,000 volts and 50,000 kv-a. interrupting capacity. It covers details of design such as the high speed solenoid operator, massive cast steel top frame, expulsion port action of arc interruption, etc.

Circuit Breakers—An 8-page bulletin, GEA 2165A, recently released by General Electric Co., describes oil circuit breakers for circuit protection and motor starting.

Circuit Breakers—The Roller-Smith Co., Bethlehem, Pa., recently released Catalog No. 3630 which illustrates and describes Outdoor Oil Circuit Breakers, rated at 7500-v. and 50,000 kv-a. interrupting capacity.

Circuit Breakers—For those interested in the principle, construction, and operation of "De-Ion" grids in extinguishing arcs in oil circuit breakers, Westinghouse announces a new illustrated 8-page folder on the subject. With the help of pictures of various "De-Ion" grid mechanisms, both general and cut-away views, the easily followed description tells the operating story of how the grids work to shorten the arc life during the breakers current interrupting cycle.

Pumps and Traps

Pumps—Two new Warren pump bulletins have recently been released. No. 225-1, 6 pp., covers the specifications, construction and capacities of the Type DB and DS single stage centrifugal pumps for heads of from 20 to 160 ft. and capacities of from 50 to 1100 g.p.m. No. 226-1, 3 pp., covers the same information on Figs. 174 and 158 simplex steam pumps for steam heating, vacuum service. The combined sizes of these two cover from 6,150 to 215,000 sq. ft. of direct heating surface drained. Warren Steam Pump Co., Inc.

Coolant Pump. Warren Steam Pump Co., Inc., has issued a 4-page bulletin describing a new Warren product known as "Coolflo," a self contained electrically driven pump designed especially for the Machine Tool Trade. Both submerged and outside mounted type are featured. In addition to photographic illustrations of these, the bulletin shows Outline Dimensions, Sectional Elevation, Performance Curves and detailed specifications.

Pumps—Automatic priming systems for centrifugal pumps operated singly or in groups are described in a leaflet issued by the De Laval Steam Turbine Co.

Pumps—Recently developed line of vertical and horizontal pumps is described in Bulletin 940 released recently by the American Manganese Steel Division of the American Brake Shoe and Foundry Co.

Vertical Pump. A new 8-page illustrated booklet (Descriptive data 3145) describing a complete line of bullet-type, vertical, hollow-shaft motors has been announced by the Westinghouse Electric & Mfg. Co. These motors, available in squirrel cage, wound motor or capacitor AC types, and also for DC operation, are designed especially for deep well turbine pumps.

Features of these motors, such as, their moisture proof ventilation, Tuffernell insulation, and the jaw type safety clutch which prevents damage to the driven apparatus, are explained and fully illustrated. Cut away photos and drawings illustrate more fully the motor's construction.

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- **Approved by Construction Codes:**
  Round Bonnets meet all requirements for low or high pressure services.
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  Pressure vessels tend to assume spherical shapes under stress. Only round bonnets keep distortion under pressure to a minimum.
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DROP FORGED STEEL VALVES

Steam Trap—The V. D. Anderson Co., Cleveland, Ohio, announces a new 39 page booklet entitled "How To Choose a Steam Trap." This book is a practical aid to steam equipment operators, and will be sent free in response to requests on company letter heads.

Trap. Nicholson Model C, a high pressure weight operated trap for steam, air or gasoline service for pressures from 500 to 1500 lb. and for temperatures up to 1000 deg. F., described in the new catalog bulletin No. 740. W. H. Nicholson & Co.

Water Treatment

Water Softeners. In connection with its entrance in the water purification field, the Worthington Pump and Machinery Corporation, Harrison, N.J., have recently issued two new catalogs, Bulletin W-210-B26 covering Pressure Filters for Water Purification and Bulletin W-210-B27 covering Hot Process Water Softeners. Worthington Pump and Machinery Corporation, Harrison, N. J.

Silica Removal. A new eight page bulletin in color has recently been issued covering the Permutit Mag-de-Sil or Silica Removal Process, perfected by the company after several years of research. The process can be adapted to either hot or cold lime soda treatment and may be applied to either new or existing equipment. The Permutit Co., 330 W. 42nd St., New York City.

Boiler Water. A new edition of "The Inside Story of Boiler Water Conditioning" has just been published by Elgin Softener Corporation. This 16-page booklet explains the wide variations in boiler feed waters and operating conditions; tells how impurities accumulate inside a boiler and how they can be eliminated; it explains the four essentials of boiler water conditioning; and tells how to maintain ideal boiler water conditions inside a boiler by using the correct treating and conditioning system for the particular job at hand.

Electrical Equipment

Small Motors—As an aid to engineers, designers, and all others concerned with the application of small motors, the Westinghouse Electric & Mfg. Co. announces its new "Small Motor Selector" guide, an illustrated folding sheet containing all essential data needed to properly fit the right motor type to any job. Covering the entire field of small motor application, from general purpose dc. up to governor controlled universal motors; and from typewriter drives to belted furnace blower drives, this new selector is an invaluable asset to the equipment designer or engineer concerned with small motor application.

Unfolded from its conveniently filable 8½x11 in. size, there appears a full size application table covering every fractional horsepower motor dc, ac, or universal, with suggested applications for each. Speed and torque data, starting data, wiring diagram, reversibility, radio interference, and numerous other factors which must be considered, are completely presented for every motor. Speed-torque curves for all motor types are included. There are written instructions and hints on what factors to consider, and the procedure to follow when selecting motors for various jobs.

The last section of the guide contains pictures and descriptions of available frame and mounting styles, for all Westinghouse fractional horsepower motors. The positive protection afforded against motor failures by the three types of "Thermoguards" is described.

Electric Cables. Bulletin GEA 2968, describes the new G. E. Nozzle-Swirl process of applying lead sheath on G.-E. paper insulated cable. This process prevents oxidized lead from getting into the cable sheath. The bulletin presents a step by step description of the process.

Electrical System—The new 64-page September, 1940, edition of the popular "Quick Selector" catalog has just been announced by the Westinghouse Electric and Mfg. Co. This is the second 1940 edition of this new handy catalog that has found such wide favor with users because of its easy reading style that simplifies selection of the correct electrical equipment for any motor, lighting. or feeder circuit.

Safety switches, No-Fuze breakers, multibreakers, distribution panelboards, motors, and motor controls are featured in successive sections of the catalog, with time-saving section index right on the front cover.

Switches — Bulletin GEA-2963B issued by General Electric Co. describes time switches for control of ac. circuits.

Transformers — Bulletin GEA-3377 entitled Ways To Save With Load-Center Distribution of Electric Power has been prepared to acquaint the industrial engineer more fully with the possibilities and economies of load-center distribution with Pyranol transformers. General Electric Co.

Transformers. Allis-Chalmers Mfg. Co., Milwaukee, Wis., have a new 16-page Bulletin, B-6095, on their high voltage power transformers. It thoroughly illustrates and describes fourteen design features available in their latest large power transformers.

Relays—A new 4-page illustrated booklet giving descriptive, construction, and electrical and mechanical data on the type SG auxiliary control relays has just been announced by the Westinghouse Electric & Mfg. Co. These relays, available for both ac. and dc. operation, have a wide application in all types and kinds of control circuits, from motor control to complicated relaying systems.

Features are described and tables give complete rating information, including coil characteristics, contact styles, etc., on both ac. and dc. types. Time delay is discussed and volt ampere burden is given for various operating conditions.

Both elementary, and wiring diagrams are given for the different styles. Accurate dimensions are included. Prices for the various style relays are contained in the data given; accessory prices for sheet metal cabinets also are contained.

Photoelectric Relays—GEA 1775C, a 4-page bulletin used by General Electric Co. describes General Electric photoelectric relays and their accessories.

Pressure Regulators. Three new bulletins of Foster pressure regulating and reducing valves have recently been issued. Bulletin No. 33, 4 pp., gives the capacity of regulators for steam service in pounds per hour for various initial and final pressures. Bulletin 35, 4 pp. gives the same data for gases in cubic feet of gas per minute for different pressures. Bulletin No. 39, 2 pp., gives data on the final condition of steam reduced in pressure through a reducing valve for pressures from 25 to 1500 lb. Foster Engineering Co., 109 Monroe St., Newark, N. J.

Voltage Regulator. Allis-Chalmers Mfg. Co., Milwaukee, Wis., has released a new Bulletin, B-6065, giving the latest information on their transformer type of distribution feeder voltage regulators. It describes the construction, operating characteristics and advantages of this modern type of equipment and gives engineering and price information on a wide range of sizes for 2400, 4800 and 6900 v.

Power Unit. A new illustrated leaflet (description data 3808) describing the recently announced "Simpac" power units has just been announced by the Westinghouse Electric & Mfg. Co. These units are self-contained a.c. generators, with integral exciters, instruments, voltage regulators and control. They are especially useful in out-of-the-way localities, or for specialized industrial applications where a.c. power is not readily available.

The leaflet contains a general description of the unit; giving its construction features and details. Each integral part of the device, such as the a.c. generator, the exciter, instruments, voltage regulator and the control are fully covered.

Contacts. A new 16-page catalog which illustrates and describes Gibsiloy electrical contacts made from ductile powdered metals has recently been issued by the Gibson Electric Co.

Known as Catalog C-10, it fully describes eight standard Gibsiloy contact materials, as follows: sliver-nickel, silver-graphite, silver-nickel-graphite, silver - molybdenum, silver - tungsten, silver-nickel-molybdenum, silver-nickel-tungsten, and silver-nickel-cadmium. All of these grades of Gibsiloy are available in various proportions of component metals in order to provide the best contact material for each individual requirement. Copies of Gibsiloy Catalog C-10 will be sent free to those requesting it on their company letterheads.

Capacitor. A NEW 24-PAGE illustrated booklet describing type FP capacitor rack and switching equipment for both indoor and outdoor service as a method for raising power factor or increasing feeder capacities has just been announced by the Westinghouse Electric & Manufacturing Company. These capacitor equipments are available in sizes from one to 1260 kv-a, one, two, or three phase for operation on 230, 460, to 13,800 v. ac.

SEAT AND DISC: 500 BRINNELL
Full plug type Stainless Steel seat and disc heat treated to 500 Brinnell hardness to prevent galling. Precision machined to give full bearing.
STEM: HIGH STRENGTH ROLLED BRONZE
Provides high resistance to corrosion to match the body of high strength bronze that resists distortion under continuous service at maximum ratings.

READING-PRATT & CADY FIG. 531-P
Union Bonnet, Full plug type, Bronze Globe Valve for heavy duty and severe throttling conditions to 350 lbs. steam and 550° F.

To Cut Maintenance Costs
OF VALVES IN AUXILIARY STEAM LINES

● The qualities you want in valves for your auxiliary steam lines have been engineered into the **531-P** for you. . . . Note that the full plug type seat and disc are of stainless steel—heat-treated to **500 Brinell hardness** to prevent galling—precision machined to have full bearing. . . . Note that you will have less trouble with body distortion even under continuous operation at maximum temperatures. Note that you will have less trouble with stem corrosion. . . . In fact, the entire make-up of **531-P** promises you long service free from maintenance. Write for complete information and recommendations.

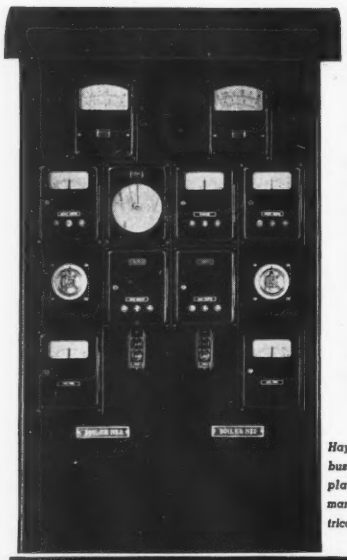
READING-PRATT & CADY
DIVISION · · READING, PENNSYLVANIA

AMERICAN CHAIN & CABLE COMPANY, Inc.

STRETCH THE STEAM CAPACITY OF YOUR PRESENT BOILERS

a prepa[illegible]ess "Must"

You can do it with HAYS Automatic Combustion Control



HAYS AUTOMATIC COMBUSTION CONTROL stretches your steam capacity because the air and fuel rates are kept in accurate proportion to each other and in direct relation to the plant load.

This permits the operation of your boilers closer to their maximum capacity with a greater degree of safety and economy than possible under manual operation.

The industrial power plant plays a vital part in the nation's defense program. This is especially true in the process industry. "Whether it makes its own electricity or buys it from an inexhaustible source, the process industrial must shut down if steam fails" says a prominent industrialist.

So — look to your power plant! Be sure you can operate each boiler when necessary at peak capacity — with SAFETY and ECONOMY. *You can do it with Hays Automatic Combustion Control.*

There is a Hays engineer-representative in your vicinity ready to consult with you on cost and other details — his name can be found in your telephone directory or we will send it upon request.

Hays Automatic Combustion Control in the plant of an eastern manufacturer of electrical instruments.

Send for this new booklet just off the press "Automatic Combustion Control and Its Relation to Lower Steam Costs"

Individual.....

Firm Name.....

Address.....

P.P.E.

The HAYS CORPORATION
COMBUSTION INSTRUMENTS AND CONTROL
MICHIGAN CITY, INDIANA, U.S.A.

Reliable Buying Bulletins

In these pages you will find advertisements of firms that make every type of machinery and equipment for generating, distributing and utilizing power. Their messages constantly record latest progress in power plant equipment. They tell you who makes it, who stands behind it. Consider their advertisements as convenient and reliable buying bulletins.

Miscellaneous

Air Washers. Clear Fresh Air is the title of a new 28 pp. bulletin No. 3142-A in color on Buffalo air washers. Construction features, application and data on five types are included together with information on their control and application for different services. The Buffalo Forge Co.

Plastic tubing. "Both sides of the Story of Insulating Tubing" is the title of a new 2 pp. folder describing IRV-O-VOLT Varnished Inside-and-Out Tubing. The folder includes a sample of this electrical insulation tubing and describes its outstanding advantages with data on A.S.T.M. tests, uses, sizes available, colors, and cost. Irvington Varnish & Insulator Co.

Magnet coils—Precision Paper Tube Co., 2033 West Charleston Street, Chicago, Ill., have just issued a new bulletin, with bobbin data sheet, illustrating and describing their line of dielectric paper coil bobbins. Where space becomes an important factor, a comparison between layer and bobbin wound coils is given and illustrated, showing the advantages of using Precision Bobbins.

Manufacturers of coils, relays, solenoids, small motors, photo-electric devices and other electrical actuated equipment using coils, will find this bulletin most interesting. A copy may be secured by writing to this publication or direct to the manufacturer.

Load Analyzer—Electrical Facilities, Inc., of Oakland, Cal., have issued Catalog Sec. C, Bulletin 300, describing the Knapp Load Analyzer. This is a compact, portable instrument, complete with cover and carrying handle designed for making power factor and related measurements. It accomplishes the measurement of power factor, watts and volts in an entirely new and uinque manner. Current ranges are 0.5, 1, 2.5, 5, 10, 25, 50 and 100 amp. which permit wattage measurements from 10 to 12,000 watts with the 120 v. instrument, from 10 to 24,000 and 10 to 48,000 watts on the 240 and 480 v. instruments.

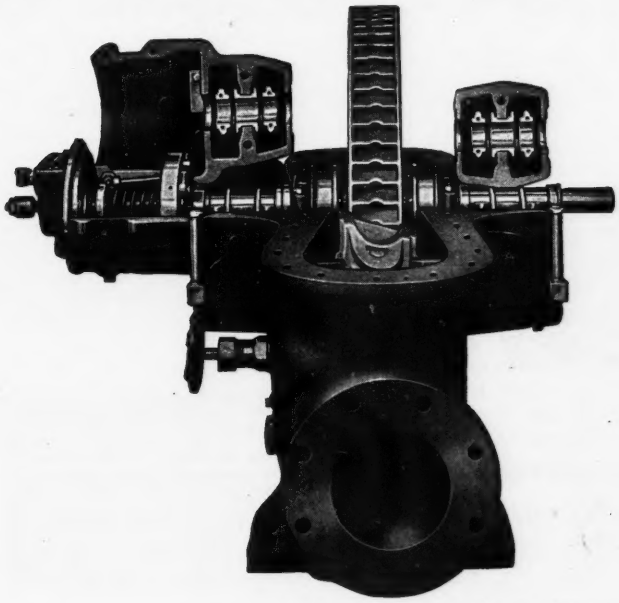
Insulated Pipe Units—Ric-wiL Co., Cleveland, O., has recently released Bulletin No. 4013 entitled Ric-wiL Insulated Pipe Units for Underground Steam Lines.

Ric-wiL Units at present are significant in industrial and defense construction work.

Roller Chain—A new, comprehensive catalog, engineering data book, and price list on Morse Roller Chain has just been issued by the Morse Chain Company of Ithaca, N. Y. The new 92 page book, Bulletin R-40, contains complete information on the construction of the channel-lubricated, interchangeable roller chain, details of adaptions and applications, tells how to select the right chain for your drives, gives performance data and engineering information. In addition, Bulletin R-40 features illustrations and specifications of regular and special types of sprockets, with recommendations for their proper use. The complete price list for chains and sprockets is also included.

Dust Collection. Dust in Industry, Its Control and Collection is the title of an attractive and informative 24-page booklet issued by the Buell En-

TERRY



ROTOR AND BUCKETS ALL IN ONE PIECE

In the Terry Turbine the wheel is made from a single forging of special composition steel. The buckets are milled directly in the wheel, there are no parts to become loose or work out, such construction makes for long life and low maintenance.

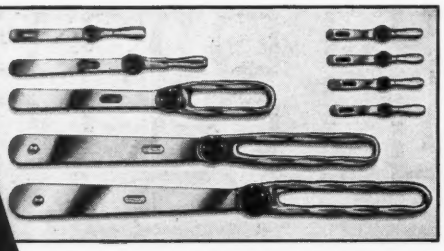
This and many other features of Terry Wheel Turbine design are described in our Bulletin S-116. A request on your business letterhead will bring a copy.

T-1138

THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD, CONN.

ADVERTISING PAGES REMOVED

NOW a Torqometer FOR EVERY TORQUE CAPACITY



● From a handle length of 4½ feet and a capacity of 1,500 ft. lbs., Snap-on "Torqometers" range in size all the way down to a midget 12" long overall with a 12½ ft. lb. capacity. And each instrument gives you **absolutely true readings that never vary,** no matter how you hold, pull or jiggle the tool. This extreme accuracy has made Snap-on "Torqometers" as indispensable as micrometers in any work requiring close tolerances. The two largest models are supplied with built-in ratchet, while ratchet adaptors are available for other sizes. Our engineering facilities in the handling of torque-measuring problems are available to manufacturers without charge. Write for catalog and full information.

Snap-on Wrenches

The Best Tools are the Safest Tools

SNAP-ON TOOLS CORPORATION
Dept. P P E-11
Kenosha, Wisconsin

SAUERMAN SCRAPERS for COAL STORAGE

● Because a SAUERMAN Scraper stores coal in thin compact layers, the pile it builds is free from air pockets and the main cause of spontaneous combustion is thus positively eliminated.

This advantage alone is sufficient recommendation to many engineers with coal storing problems, and additional exclusive SAUERMAN Drag Scraper features make them a logical choice.

SAUERMAN Scrapers save money on coal handling, moving the fuel into and out of storage at a very low cost per ton. They utilize the maximum storage space of odd and irregular shaped areas. Units are operated from one stationary point that may be enclosed to protect the single operator required against the weather. They are exceedingly low in maintenance costs, and each scraper unit is a permanent lifetime, trouble-free installation.

● If you are planning or plan to store coal, it will pay you to write for the SAUERMAN Coal Handling Catalog. This 56 page book shows many installations and gives approximate cost figures for coal handling.

Above: A ¾ cu. yd. SAUERMAN Scraper stores coal on a long narrow strip of ground. This is small but active storage, as scraper not only piles incoming coal but keeps bunkers filled which requires the reclaiming of 160 tons per day.

Below: At the Municipal Electric Plant, Belfast, Ireland, this 2 cu. yd. Scraper handles 90 tons of coal in or out of storage hourly. Area covered is a quarter-circle with a 350 ft. radius. Maximum capacity is 40,000 tons.

SAUERMAN BROS., INC.
486 S. Clinton St., Chicago, U. S. A.

gineering Co., Inc. The booklet has two sections. Section one embodies general information on dust collection; section two, deals specifically with the Van Tongeren Theory and its advantages. The booklet therefore is of interest to plant executive, engineer or technician.

Vibration Dampener—New bulletin No. 6878 describes the new V.D.B. (Vibration Dampener Bushing) resilient mounting now being built into Manhattan wheels for portable grinders to eliminate vibration, give better finish with less fatigue and increased production. The Manhattan Rubber Mfg. Division of Raybestos-Manhattan, Inc.

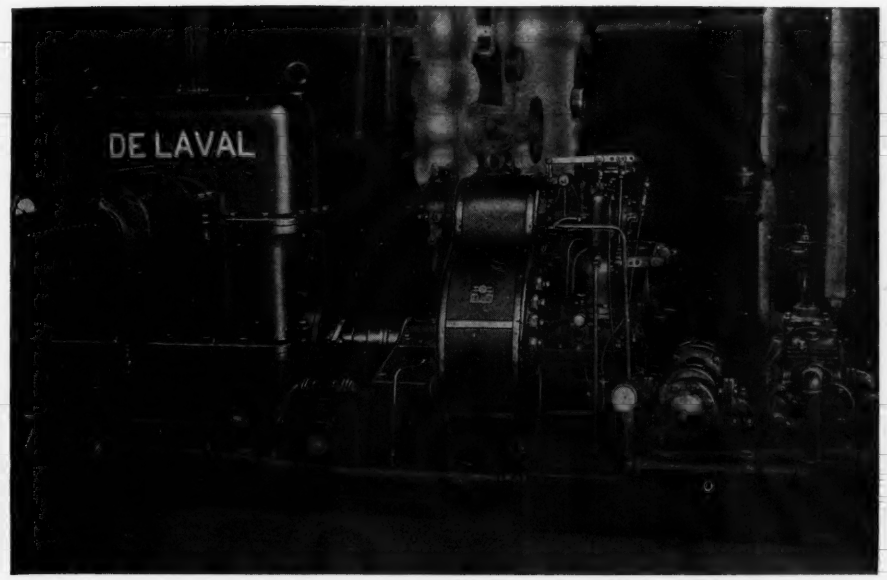
Insulation Testers—James G. Biddle Co. has recently published Bulletins 1655 and 1660 explaining a hitherto not-too-well understood characteristic of insulation of nearly all types of electrical equipment, known as "Dielectric Absorption." This effect is more pronounced in large equipment, such as generators and long cables than it is in the ordinary run of mine electrical apparatus. So, in these bulletins they have approached the subject: (a) From the viewpoint of getting results with hand driven "Megger" insulation testers (Bulletin 1655) intended especially for industrial plants; and (b) for dielectric absorption measurements in large equipment using motor driven 'Megger" testing sets as described in Bulletin 1660.

Photometer—An 8-page bulletin issued by Photovolt Corporation describes the "Photrix" Small Spot Photometer. This is a highly sensitive photoelectric light meter with electronic amplification for measuring low light in small areas. It operates on ac. or dc. and is fully balanced for line voltage variations without the use of batteries or voltage stabilizers for the power supply. The Photometer is a portable unit comprising an instrument proper and a search unit. The latter houses the phototube with a turntable disc having various openings which are used to obtain four sensitivity ranges in the ratio of 1, 10, 100 and 1000. The high sensitivity of this instrument makes it suited for measuring fluorescence, weak ultra-violet radiation, etc.

Conveyors—The C. O. Bartlett & Snow Co., Cleveland, O., is starting the distribution of its new No. 90 General Catalog, replacing the former No. 50 and No. 74 catalogs. The new book—372 pages—gives complete details of Bartlett-Snow elevators and conveyors, chains and sprockets, crushers, gates and miscellaneous equipment.

Steel Grating. Blaw-Knox Co., has prepared a new catalog (No. 1773) on its electroforged steel grating and stair treads. A section devoted to a description of the method of manufacturing this product also portrays a micrographic analysis of the forged structure of the grating. The booklet illustrates a diverse range of uses, applying to many industries, and contains a table of safe loads and size variations.

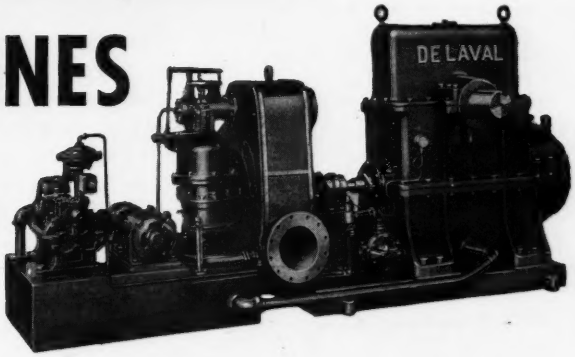
Fuels — Coal Preparation — How modern coal preparation methods affect uniformity in the size, quality and performance of Fidelity and Buckheart Precision Washed coals is told in a new 4-page bulletin by the United Electric Coal Cos.



Turbine and worm gear drive of paper machine. The turbine delivers 225 hp. at 3900 r.p.m. and exhausts to the drying rolls against 20 lb. back pressure.

• *Below*
Shop view of exhaust side of Turbine and Worm Gear unit, showing governor, motor driven De Laval—IMO oil pump and standby steam pump, also oil cooler.

DE LAVAL TURBINES INCREASE PRODUCTION



THE speeds of paper machines are being stepped up in order to increase production, but the higher the paper speed, the closer must the speed be held, since irregularities result in non-uniform product, breakage and expensive loss of time and output.

The **DE LAVAL VARIABLE SPEED TURBINE** assures extremely close regulation over a wide range of load and speed.

Power is developed as a by-product of the steam used in the drying rolls and coils.

The **DE LAVAL WORM GEAR** is exceptionally compact and provides for placing the drive at the middle of the paper machine line shaft, since the gear shaft can be extended on both sides.

Similar production economies may be realizable in your plant. State conditions and ask for Publication T-3518.

DE LAVAL *Steam Turbine Co.*
TRENTON, N. J.
MANUFACTURERS OF TURBINES — STEAM, HYDRAULIC; PUMPS — CENTRIFUGAL, PROPELLER, ROTARY DISPLACEMENT, MOTOR-MOUNTED, MIXED-FLOW, CLOGLESS, SELF-PRIMING; CENTRIFUGAL BLOWERS and COMPRESSORS; GEARS — WORM, HELICAL and FLEXIBLE COUPLINGS

Gives QUICK Answers to ALL Flow Questions

HOW much water is going into steam? . . . Are boilers working at top efficiency? . . . How much gas are we using each day? . . . Let a Simplex Meter give you the quick, accurate answers to these important plant flow questions.

Simplex Meters can be used with any type of pressure producing device (orifice, nozzle, venturi tube) in any size of main to totalize the flow of Boiler Feed Condensate, Steam, Air, Gases and Corrosive Liquors. It is extremely accurate and reliable over wide ranges. And its modern price puts it within easy reach of every plant. Write for new descriptive bulletin.

TYPE MS METER

SIMPLEX VALVE & METER CO., 6790 Upland St., Philadelphia, Pa.

SIMPLEX METERS

WHY WE BELONG

To ASSOCIATED BUSINESS PAPERS, Inc.

FOR the same basic reasons that you join associations to further your business interests, POWER PLANT ENGINEERING is an active member of The A. B. P.—a group of outstanding business papers pledged to uphold the highest editorial, journalistic and publishing standards.

A. B. P. publications become good advertising media by the simple method of becoming first an abundant money's worth to subscribers. Advertisers who offer to buy space just to get a product plugged editorially are not wanted. If the product is of genuine interest to our readers, our editors will mention it anyway.

Obviously, such a policy makes it easy for you to do your shopping in POWER PLANT ENGINEERING. You know that our advertisers are in it only because they consider its pages a reliable market place.

ABP

Humidification—An interesting new 8 page illustrated educational bulletin entitled "Facts You Should Know About Humidification" has just been published by Armstrong Machine Works, 810 Maple Street, Three Rivers, Michigan. It discusses the cause and cure of troubles accompanying dry air during the winter heating season. Tables list the desirable relative humidity for industrial processes, the regain for various materials, the amount of moisture required to raise relative humidity to desired point, etc. The catalog section contains data on a new line of Armstrong steam type humidifiers.

Fans. There is now available for distribution to the public a booklet published by the National Association of Fan Manufacturers entitled "The Magic of Fresh Air and Electricity" which follows the modern treatment of showing the application of ventilating equipment for use in industry, in commercial establishments and in the home.

Pipe Threading. Curtis Pipe Cutting and Threading Machines are described in a new 12-page catalog recently issued by The Curtis & Curtis Co.

Pipe Tools. Beaver Pipe Tools, Inc., Warren, Ohio, have issued two new bulletins, one entitled "What Users Say" and the other a catalog type bulletin describing new Beaver equipment.

Lighting—Hygrade Sylvania Corporation has issued an attractive 22 page catalog on their "Muralume" fluorescent lighting units. It contains complete data for selecting these units.

Lighting—"Light where you want it —plus protection," is the subject of a 4-page catalog, released by The Boyer Campbell Co.

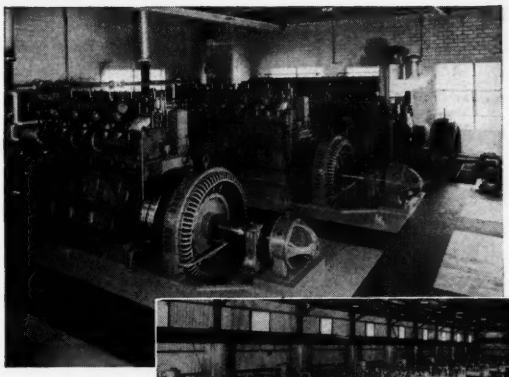
It features the universal adaptation of Marvel Shields to industrial operations and illustrates installation on stationary grinders, disc sanders, surface grinders, band filers, shapers, metal band saws, milling machines, universal tool and cutter grinders, mortising saws, lathes, etc. Marvel Shields are supplied either with a plain shatter-proof or magnifying lens, framed with a macerated resin plastic material that is strong and sturdy and a natural insulator of electricity.

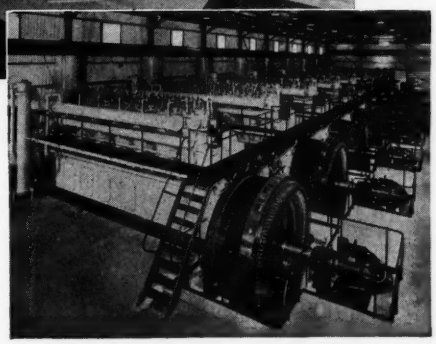
A supplementary folder, titled "Super Sight," describes this same principle of light properly directed, plus magnification adapted to first aid and hospital use.

Technical literature describing waterproofing and dampproofing of concrete and brick foundations, precast concrete piles or slabs, and for waterworks and sewage disposal plants, has just been published by Koppers Company, Tar and Chemical Division, Pittsburgh.

"Membrane Waterproofing" (Form TB-3) tells when waterproofing and dampproofing should be applied. "Dampproofing" (Form TB-4) distinguishes between dampproofing and waterproofing. "Waterproofing and Dampproofing for Waterworks" (Form TB-5) discusses circumstances under which these treatments are necessary and "Waterproofing and Dampproofing for Sewage Disposal Plants" (Form TB-2) describes the value of these applications.

LOW COST • • UNINTERRUPTED • • POWER SERVICE
A PRODUCTION FACTOR OF FAR REACHING IMPORTANCE





Above — 2165-hp. in an electrification plant

Right — 5500-hp. in a mining project

WORTHINGTON DIESEL AND GAS ENGINE ECONOMY . . . in its effect on this important factor, is a matter of definite record in hundreds of applications, in a wide variety of services.

•

An expert WORTHINGTON engineering staff . . . supported by 40 years of successful engine building and application experience . . . is available to assist in the solution of any power problem, and to render a complete and qualified recommendation for the particular conditions . . . without bias or obligation.

For Continuous Heavy Duty • Every Type of Drive

DIESEL ENGINES 50-hp. to 1500-hp.
GAS ENGINES 30-hp. to 1800-hp.
CONVERTIBLE GAS-DIESEL ENGINES 30-hp. to 1800-hp.

WORTHINGTON AUXILIARIES

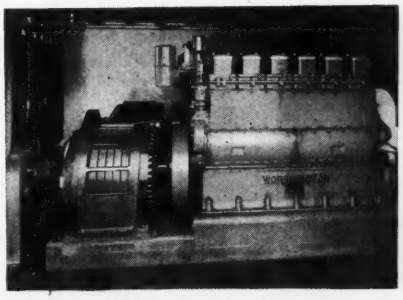
Added service security, through the undivided responsibility of one maker.

AIR COMPRESSORS FOR STARTING

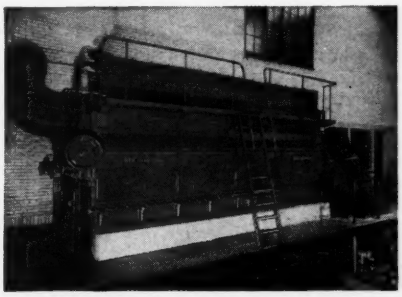
CENTRIFUGAL PUMPS FOR JACKET WATER CIRCULATION

EVAPORATIVE COOLERS FOR JACKET WATER COOLING

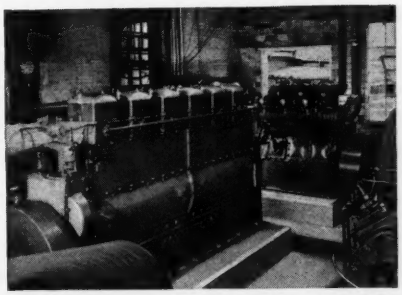
ROTARY PUMPS FOR FUEL OIL TRANSFER



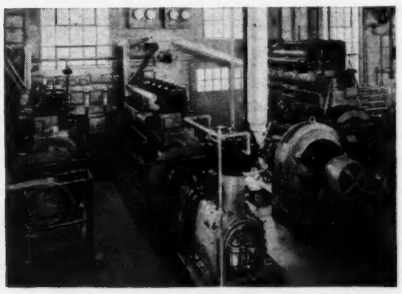
360-hp. serving a creamery



800-hp. generating power for a hospital



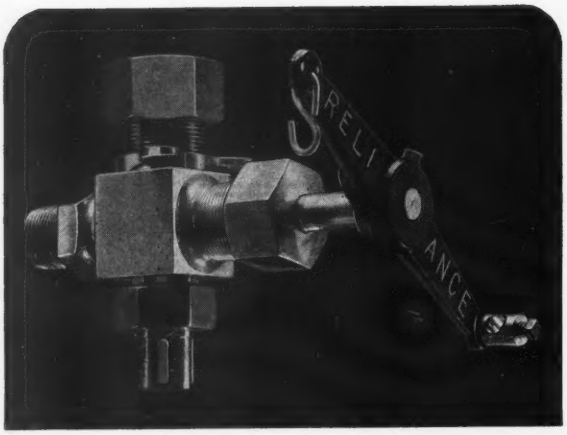
270-hp. in a general machine shop and foundry



330-hp. in an ice manufacturing plant

DEO-7 **WORTHINGTON PUMP AND MACHINERY CORPORATION** • *General Offices:* **HARRISON, NEW JERSEY**

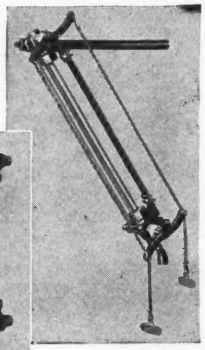
WORTHINGTON

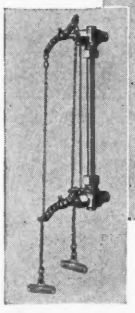


How to Prevent Costly Water Gage Failure *with RELIANCE Gage Valves*

"Steam-proof" and "leak-tight"—that's the kind of protection you get in Reliance Gage Valves. They guard against leaks and sputtering and fizzing on your water columns. And you don't have to "shell out" for frequent repairs and replacements • Reliance Valves have a substantial way of winning your admiration. They're quick-closing—chain operated. Bodies of tough bronze, polished; monel discs, bronze seats. Extra heavy to withstand 450 lbs., 550° F. easily. Complete line includes valves for lower pressures • It's important and valuable to have worry-free valves that save expense and annoyance as thousands of plants, large and small, have proved with Reliance Valves. *Write today for new Bulletin 401.*

The Reliance Gauge Column Co.
5902 Carnegie Ave • Cleveland, Ohio





• Reliance Water Gage for vertical use. Also available with flanged connections.

• Reliance Tiltview (pat'd) Water Gage, for easier visibility where gages are high above the floor.

Reliance
TRADE MARK REG. U.S. PAT. OFF.
Boiler Safety Devices since 1884

Census of Steam Engine Manufacture

PRELIMINARY report has just been released by the Bureau of Census summarizing the return of the 1939 Census of Manufacturers of establishments whose principal products are steam engines, steam turbines, water wheels and water turbines. This report, however, does not include turbo-generators, small steam turbines made to be installed in blowers, pumps, etc., locomotives, and steam engines for ships made in these plants. It, therefore, represents only part of the entire field and needs to be interpreted with these limitations in mind.

The eighteen establishments of this industry operating in 1939, turned out $24,751,466 worth of goods. In 1937, the 22 establishments then in existence produced total products valued at $22,424,777. This industry is one of those rated among the 75 industries whose products are considered essential to the national defense.

Of the $24,751,000 of products manufactured by this industry during 1939, approximately two-thirds or $16,883,000 represented the value of steam engines, turbines, water wheels, and parts. Secondary products turned out by this industry amounted to $7,011,000, while $783,996 represented receipts from contract and repair work and $74,256 the value of miscellaneous products not specified.

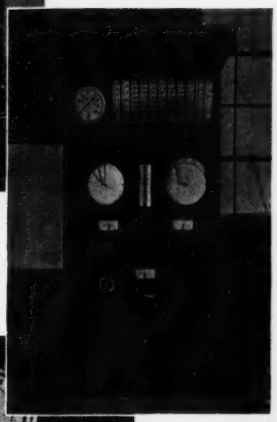
A breakdown of the 1939 production of these items manufactured by all industries discloses that 332 reciprocating steam engines, 122 marine, 2196 other than marine steam turbines, and 145 water wheels and water turbines were manufactured. The reciprocating steam engines, whose horsepower aggregated 112,115, had a factory value of $1,035,255; the marine turbines, representing an aggregate horsepower of 702,760, were valued at $8,369,081; other than marine steam turbines, 514,715 hp., were valued at $7,034,071, while the water wheels and water turbines, which together had a total of 846,226 hp., had a value of $5,981,691. Parts and attachments for steam engines and turbines manufactured by all industries during 1939 totalled $1,969,611 in value, while parts and attachments made for water wheels and turbines reached a value of $850,919.

Marine Turbines Doubled

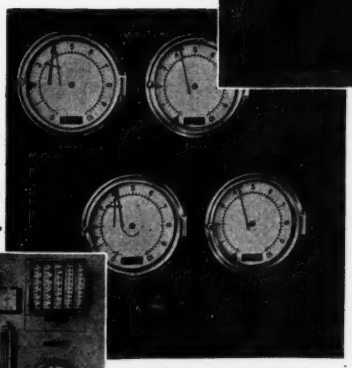
A comparison of figures shown for the two censuses reveals that in 1937 production in reciprocating steam engines and in other than marine turbines was higher than in 1939, while in marine steam turbines, water wheels and water turbines and in parts and attachments, the value of the products in 1939 was substantially higher. In 1937 a total of $2,826,318 worth of steam engines were produced compared to the $1,035,255 produced last year. The 1937 production of other than marine steam turbines amounted to $12,860,673, while last year this item amounted to only $7,034,071. This, however, was more than compensated by the fact that the 1939 production of marine steam turbines

COCHRANE at PURDUE

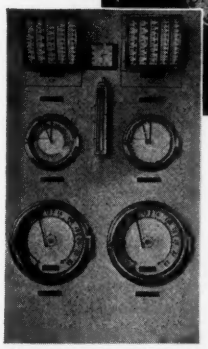
Central Power & Heating Plant, Purdue University, West Lafayette, Indiana.



On panel at right is shown Cochrane Recording, Indicating and Integrating Flow Meter with temperature and pressure pens measuring 60,000 lb./hr. at 205 lb. pressure.

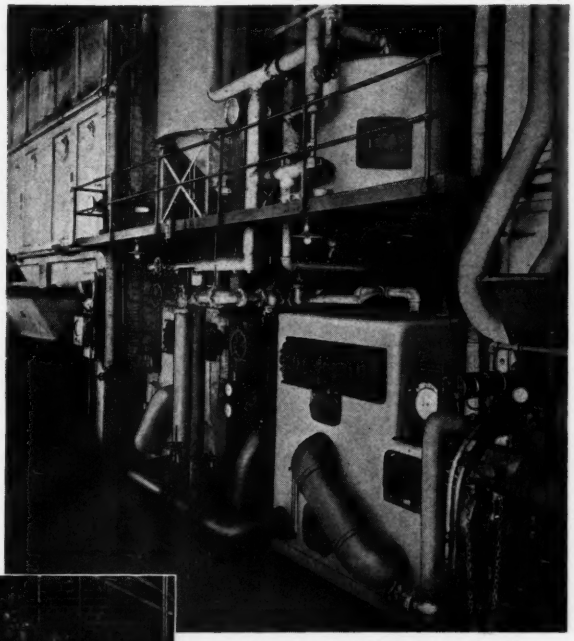


Cochrane Recording, Indicating and Integrating Mechanical Flow Meters. (1) Measuring Turbine Steam with temperature and pressure pens.

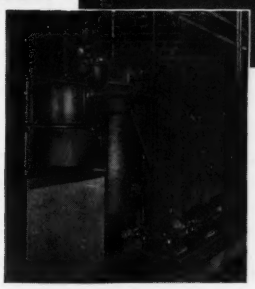


(2) Measuring Auxiliary Steam. (3) Measures low pressure heating steam with temperature and pressure pens. (4) Measures 150 lb. steam.

At bottom of panel, Cochrane Recording, Indicating and Integrating Mechanical Flow Meter with aluminum doors. (1) Measures steam flow from boiler No. 6. (2) Measures steam flow from boiler No. 5.



At top left: 3200 GPH Cochrane Hot Process Softener with 5'0" Cochrane Vertical Filter.
Lower right: Cochrane Open Heater with Cochrane V Notch Recorder.
Lower left: Cochrane Open Heater.



At left: Cochrane Chemical Proportioner, pump set and mixing tank.

A MODEL POWER PLANT is that of the Central Power & Heating Plant of Purdue University at West Lafayette, Indiana. • At Purdue every measurable quantity in the boiler plant is metered, so that records are available on all operating equipment — one reason why power cost is kept low — often as low as $0.004 per kw. • Cochrane equipment has contributed to Purdue's economical operation for more than 17 years. Starting with a Cochrane Hot Process Softener with vertical filter and open heater installed in 1924, the latest additions were Cochrane Electric Flow Meters purchased in 1939. • Cochrane power plant equipment has "graduated with honors" not only in engineering colleges, but in the "School of Hard Knocks," the testing ground of America's largest industries.

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Fairbanks Iron Valves on House Service Pumps, Hotel New Yorker, New York.

Valves, like other equipment in hotels, must give service 24 hours a day, 7 days a week.

To assure dependable control of the water service for the 2500 rooms in the Hotel New Yorker, New York, Fairbanks Valves were installed throughout the entire plumbing system.

At a recent interview, Mr. W. D. Lewis, Chief Engineer, stated that their Fairbanks Valves have cost practically nothing for upkeep during the many years they have been in service and that no repair parts have been required.

Fairbanks Valves are made in globe, gate, angle, check and cross patterns for a large range of pressures . . . in metals best suited for the service desired.

Our engineers are, at all times, ready to assist in solving difficult valve problems without cost to you.

Write for name of our nearest distributor and catalog No. 21.

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Fairbanks
***Standard and Renewable* Valves**

was about double that of 1937. Last year factories turned out $8,369,081 worth of marine turbines against $3,353,790 turned out in 1937. The value of water wheels and water turbines manufactured in 1939 was almost twice that for 1937—$5,981,691 in 1939 compared to $2,967,062 for 1937.

The report includes statistics on the engines, turbines, and water wheels by twelve different horsepower classifications. Of the 332 steam engines produced, 75 were of a horsepower rating between 1000 and 5000, 73 between 100 and 200, 68 between 20 and 50, and 38 between 10 to 20. None were produced in the 5000 horsepower or over class.

The industry spent $9,551,498 for materials, supplies, fuel, purchased electric energy, and contract work in 1939 against $7,011,880 in 1937. But while production and expenditures were higher last year than two years before, the value added by manufacture dropped 1.4 per cent from $15,412,897 to $15,199,968. The value added by manufacture includes the value of products minus cost of materials, supplies, fuel, purchased electric energy and contract work.

All figures for 1939 are preliminary and are subject to revision in the final report.

Power Topics Prominent In ASME Program

THE Sixty-first Annual Meeting of The American Society of Mechanical Engineers to be held in New York City Dec. 2-6, 1940, with meeting headquarters at the Hotel Astor instead of the Engineering Societies Building, where meetings have been held in former years, more than 100 technical papers in such specialized mechanical-engineering subjects as aeronautics, applied mechanics, fuels, hydraulics, metals engineering, machine-shop practice, management, materials handling, petroleum, steam power, railroads, textiles, heat transfer, and process industries will be presented by leading experts in the field.

The banquet on Wednesday evening, Dec. 4, will feature two outstanding addresses, one by A.S.M.E. President Warren H. McBryde, San Francisco, Calif., and the second by a nationally famous member of the National Defense Commission. In addition, President McBryde will present to outstanding American engineers the 1940 awards of the Society.

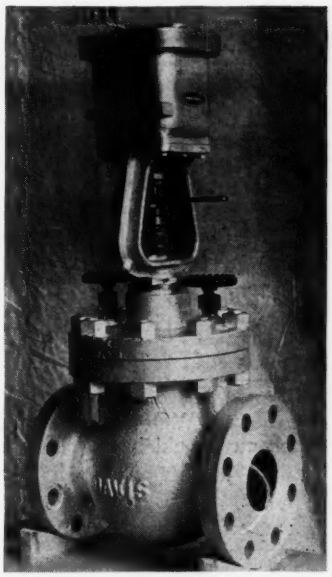
Features on the technical program having to do with power plant engineering are as follows:

Monday, Dec. 2—New Data on Coal Ash in Boiler Furnaces, by E. G. Bailey, V. P. Charge of Engrg., Babcock & Wilcox Co.; Lubrication of General Electric Steam Turbines, by C. Dantsizen; Lubrication Studies, Virgil M. Palmer and Charles Pope, Eastman Kodak Co.; Silica, by Harold Farmer, Chief Chemist, Philadelphia Electric Co.; Silica Removal, by H. L. Tiger, V. P., The Permutit Co.; Problem of Boiler Feedwater Treatment at New High-Pressure Installation at Waterside Station, by W. E. Caldwell, Consolidated Edison Co.; Absorption Process

SOLENOID VALVES

Designed for Heavy Duty Industrial Service

DAVIS Solenoid Valves		Steam, Air, Gas and Liquids						Liquids						Water and Air	
Valve No.		90	93	93H	94	99	298	97SD	97SH	97SL	97TD	97TH	97TL	380	383
Service	Continuous Duty	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓
	Emergency Service						✓								
	Proportioning Service										✓	✓	✓		
	Pilot Service (3 or 4 Way													✓	✓
	Vacuum Service							✓		✓					
Max. Working Pressure		200	200	200	200	200	200	50	200	35	50	200	35	150	50
Single Seat, Direct Acting							✓	✓		✓	✓		✓		✓
Single Seat, Pilot Operated			✓	✓	✓	✓	✓		✓			✓			
Double Seat, Balanced		✓												✓	
"Packless" Head							✓	✓	✓	✓	✓	✓	✓		
Alternating Current		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Direct Current		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Range of Sizes, Scr'd.		½"-4"	½"-4"		½"-4"	½"-4"	½"-4"	½"-4"	½"-4"	½"-4"	½"-2"	½"-2"	½"-2"	⅛"-2"	¼"-½"
Range of Sizes, Fl'g'd.		1½"-4"	1½"-4"	4"-12"	1½"-4"	1½"-4"	1½"-12"	2"-4"	2"-4"	2"-4"					
Material Specifications — Body	Bronze	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Semi-Steel	✓	✓	✓	✓	✓	✓	✓	✓	✓					
	Stainless Steel							✓	✓	✓	✓	✓	✓		
	Monel							✓	✓	✓	✓	✓	✓		
	Nickel							✓	✓	✓	✓	✓	✓		
	Steel	✓	✓	✓	✓		✓								
Material Specifications — Trim	Bronze	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Stainless Steel	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Monel							✓	✓	✓	✓	✓	✓		
	Nickel							✓	✓	✓	✓	✓	✓		



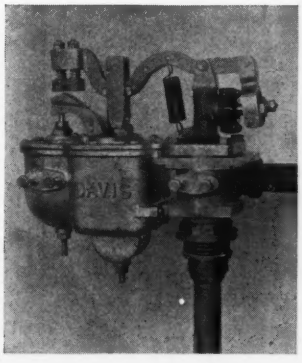
Above is shown a No. 93 H unit with solenoid operated pilot valve and hydraulically actuated main valve built for use on a 400 lb. pressure water main.

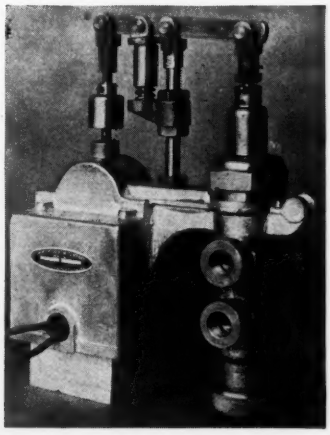
THE application of solenoid valves for automatic electrical control of fluids and gases is one of the most fertile fields ever opened up to engineering ingenuity. The opportunity for plant engineers to discover new and distinctive uses for solenoid valves is still almost limitless. In addition to offering a wide variety of basic units built to stand up under heavy industrial service, Davis has developed a number of special types that still further extend the possibilities. We invite you to send for the Davis Solenoid Valve Catalog which gives detailed information about the valves listed in the above table. Write to DAVIS REGULATOR CO., 2508 S. Washtenaw Ave., Chicago, Ill.

LEFT — No. 93 is a simple general purpose valve with a multitude of applications.

●

RIGHT — No. 97 TH features a patented throttling action for container filling and proportioning service. All parts are removable for cleaning.





No. 380 is a 3 or 4-way pilot valve widely used on air or liquid actuated power cylinders.

DAVIS REGULATOR CO.

PRESSURE REGULATORS • STOP AND CHECK VALVES • LIQUID LEVEL CONTROLLERS • BACK PRESSURE VALVES
STRAINERS • PUMP GOVERNORS • BUTTERFLY VALVES • FLOAT VALVES • RELIEF VALVES • SOLENOID VALVES
MOTOR OPERATED VALVES • NON-RETURN VALVES

Here are TWO handy helps that every engineer and mechanic should have, and which are available without charge to the readers of this magazine.

1—*A durable metal protractor,* with black letters on a white background for greatest legibility, with angles reading in both directions, and with an inch scale on the straight side.

2—*The 40-page Smooth-On Handbook,* with simple instructions for time-saving, labor-saving and money-saving repairs to equipment all over the plant. Illustrated by 170 diagrams.

The instructions in this handbook are based on the experience of thousands of engineers, and include much information not to be found in any other publication. Some of the subjects covered:

How to seal cracks in casings or shells of pumps, heaters, condensers, evaporators, tanks, engines, valves, etc.

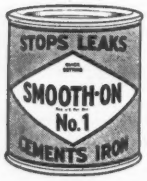
How to stop leaks at seams, bolts, rivets, threaded or flanged joints, etc.

How to tighten loose parts of apparatus, fixtures, etc.

How to waterproof concrete, brick or stone floors, walls, cisterns, etc.

How to improve the appearance of rough or blemished machinery bases and other castings

How to make up leak-proof pipe joints



Get Smooth-On No. 1 in 7-oz., 1-lb. or 5-lb. can, or in 25-lb. or 100-lb. keg from your dealer, or if necessary from us. For your protection, insist on SMOOTH-ON, used by engineers and repair men since 1895.

Send the coupon TODAY to be sure to receive the free protractor and repair handbook before the supply is exhausted.

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for Removal of Soluble Silica from Water, by L. Drew Betz, Dir., Chas. A. Noll, Chief Chemist and John J. Maguire, Asst. Tech. Dir., W. H. & L. D. Betz.

Appealing to Boiler and Furnace Interests

Tuesday, Dec. 3—The Production of Seamless Tubes by the Combined Effects of Cross-Rolling and Guide Discs, by W. Trinks, Prof. M. E., Carnegie Inst. Tech.; Thermostatic Time Lag, by Rudolph Beck, Res. Engr., Manning, Maxwell & Moore, Inc., American S. & B. Div.; Asymototic Reset Controllers, by R. P. Lowe and Ed S. Smith; Continuous Heat Balance Control of Boiler Room Operation, by B. S. Murphy, Chief Engr., Hudson Ave. Sta., Brooklyn Edison Co., Inc.; Flow Processes in Underfeed Stokers, by Martin A. Mayers, Coal Res. Lab., Carnegie Inst. of Tech.; Steam Temperature Control Systems for Modern Steam Generators, by M. H. Kuhner, Ch. M. E., Riley Stoker Corp.; Analysis of Flow in Tubes of Large Steam Generating Units, by John VanBrunt, V. P. Charge Engr., Combustion Engrg. Co., Inc.; Some Particulars of Design and Operation of a Twin Furnace Boiler, by John Blizard, Head Res. Dept., and A. C. Foster, M.E. Chg. Pulv., Fuel Design, Foster Wheeler Corp.; Effects of Surface Finish on Journal Bearing Performance, by J. T. Burwell, Jr., Res. Assoc., Mass. Inst. Tech.; Elastic Shaft Couplings for Use with Internal Combustion Engines, by J. Ormondroyd, Prof. of Engrg. Mechanics, Univ. of Michigan; Automatic Control of Surge Tanks, by Philbrick, J. B. McMahon and H. L. Mason, Foxboro Company; Combustion Explosions in Pressure Vessels Protected with Rupture Discs, by Merl D. Creech, Develop. Engr., Black, Sivalls & Bryson, Inc.

Steam Power Engineering in Simultaneous Sessions

Wednesday, Dec. 4.—A New Steam Engine and Boiler, by John I. Yellott, Illinois Inst. of Tech., and S. L. G. Knox, V. P. & Chief Engr., Bucyrus Co.; Determination of Steam Quality, by Frederick G. Straub, Prof. of Chem. Engrg., and Elwood E. Nelson, Chem. Engrg. Dept., University of Ill.; Relationship of Viscosity to Rate of Shear, by L. J. Bradford and F. F. Villforth, Jr., Penna. State College; The Radial Multiple Oil Film Bearings, by Gustave Fast, Pres., Fast Bearing Co.; Progress Report on Study of Viscosity-Pressure Relationships, by A. E. Norton (deceased) and J. R. Muenger, Harvard Engrg. School; Pressure Loss Formulas for Centrifugal Dust Collection, by Marcel A. Lissman and Franklin Miller, Western Precipitation Co.; Recent Experience in the Application of Wet Type Dust Scrubbers (representation) by A. W. Anthony, Jr., Pease-Anthony Equipment Co., and R. V. Kleinschmidt; Water Purification and Treatment in the Textile Industry, by Sheppard T. Powell and H. E. Bacon; Development and Use of Anti-Friction Bearing in Textile Industry; Power Losses in High Speed Journal Bearings, by F. C. Linn, Engr. Design & Develop., and D. E. Irons, Turbine Engrg. Dept., General Electric Co.; Friction in Ball Bearings, by

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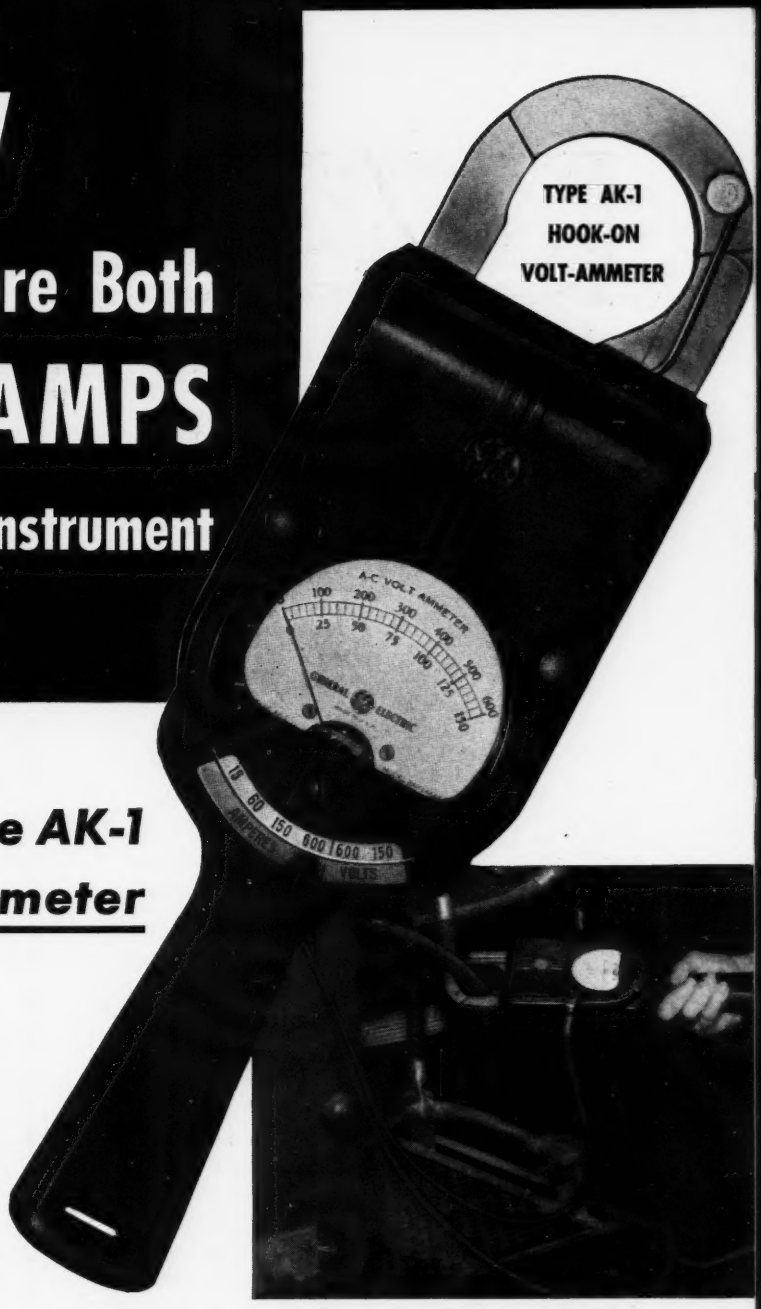
You Can Measure Both VOLTS and AMPS with a "Hook-on" Instrument



That's Why We Call the AK-1 A Hook-on Volt-ammeter

IT'S no trick at all to measure both alternating current and voltage with it. All you do is hook the instrument around the line and read amperes. Then connect the leads to the binding posts and read volts.

No Additional Equipment Needed

You don't need a separate transformer, voltmeter, or any other additional equipment. And you don't need to cut conductors or shut down equipment to make your measurements.

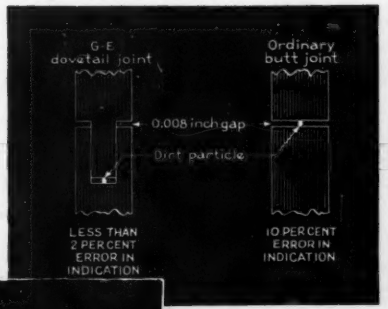
One Setup to Measure Current and Voltage

After measuring voltage, leaving the leads connected does not affect hook-on current readings. Just flick the selector switch to either "Amperes" or "Volts" according to the measurement you want.

Our bulletin GEA-2950 describes the AK-1 in detail, and illustrates how easy it is to use. Order a copy from your nearest G-E Office, or write General Electric, Schenectady, N. Y.

For Emergency and Maintenance Testing

This instrument is particularly handy for quick, accurate measurements when you have trouble with electric equipment and need the answer to circuit conditions in a hurry. Also, you will find it very useful for checking the loading of motors, and for other routine maintenance measurements.



Special Dovetail Joint Assures Consistently Accurate Readings

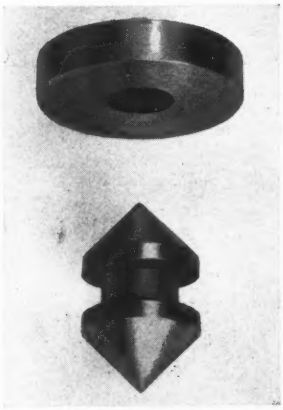
The hook that closes around the conductor has a dovetail joint which minimizes errors caused by unnoticed dirt lodging between the jaws of the instrument. Particles of dirt which would cause large errors in the ordinary butt joint have almost negligible effect on the readings obtained with the AK-1.

GENERAL ELECTRIC

K-MASTER

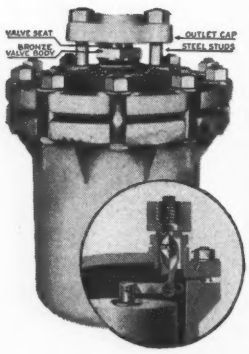
INVERTED BUCKET STEAM TRAP

Double Valve and Seat Double Life



In effect, The K-Master Trap is two traps in one. In so far as valve life is concerned, you get twice as much trapping for your money.

Valves and Seats in K-Master Standard Traps are reversible. And it sure is a simple matter to get at the valve and seat to reverse them. Note in the small picture how they are located in an external assembly. The cover does not have to be removed.



Thus, with the K-Master you get double valve life and spend only a few minutes reversing the valve and seat. Contrast this with the half-hour to an hour spent in inspecting and changing the valve in an ordinary trap. Try out a K-Master and check this feature for yourself, as hundreds of others have done.

. . .

Exhibiting at the New York Power Show

KAYE & MACDONALD, Inc.

92 Franklin Avenue West Orange, N. J.

H. Styri, Dir. of Res., SKF Industries; A Case Study of Electrical Rates and Service in a Suburban Community, by Gregory M. Dexter, Engrg. Assoc., Bitting, Inc.; A Mechanical Method for Solving Pipe Problems Involving Temperature Expansion, by F. M. Hill, Engr., Commonwealth & Southern Corp.; Condenser Tubes and Their Corrosion, by C. W. E. Clarke, Cons. Engr.; and A. E. White, Dir. Dept. of Engrg. Res., Univ. of Mich.; Flow of Saturated Water Through Orifices, by M. W. Benjamin, Engr., and J. G. Miller, Engr., Engrg. Div., Detroit, Edison Co.; The Annis Meter for Measuring Flow at the Intake End of Closed Conduits, by R. K. Annis, Cons. Pump Designer, and M. B. MacNeille, Ch. Engr., Hyd. & Dealer Div., Fairbanks, Morse & Co.; Effect of Ambient Temperature on the Coefficients of Venturi, by W. S. Pardoe, Prof., Dept. C. E., Univ. of Penna.; Discharge Coefficients of Long-Radius Flow Nozzles When Used with Pipe-Wall Pressure Taps, by H. S. Bean, Sr. Physicist, Ch. Gas Measuring Instruments Sec., Nat'l. Bureau of Standards; S. R. Beitler, Assoc. Prof. of M. E., Ohio State Univ., and R. E. Sprenkle, Meter Engrg. Dept., Bailey Meter Co.; Calibration of Volumeters, by E. E. Ambrosius, Asst. Prof., Univ. of Okla.

Day for Hydraulic Engineers

Thursday, Dec. 5—Mechanical and Hydraulic Features of the Wheeler, Pickwick Landing, Guntersville and Chickamauga Hydro-Electric Project of the T. V. A., by J. F. Roberts, Senior M. E. for T. V. A., and George R. Rich, head M. E. & Asst. Chief Design Engr. for T. V. A.; Heat Transfer to Gases Inside Tubes, by H. O. Croft, Prof., University of Iowa; The Development of the Automatic Adjustable Blade Type of Propeller Turbine, by R. V. Terry, Hyd. Engr., Newport News Shipbldg. & Drydock Co.; Speed Regulation of Kaplan Turbines, by J. D. Scoville, Asst. Ch. Engr., S. Morgan Smith Co.; A High Temperature Bolting Material, by A. W. Wheeler, Turbine Engrg. Dept., General Electric Co.; Effect of Structure on High Temperature Properties of Carbon-Molybdenum Steel, by A. E. White, Prof., Dir. of Dept. of Engrg. Res., Univ. of Michigan, and Sabin Crocker, Sr. Engr., Engrg. Div., Detroit, Edison Co.

Guard Public Properties

PUBLIC utility managers are making a concerted effort in the national defense program to insure the protection of such public service properties as power, water supply, transportation, fire protection, radio, telephones and telegraph. Key men in these industries are urged by the Water and Sewage Works Manufacturing Association, through its president, Col. W. F. Rockwell, to take steps to prevent possible internal damage to plants and services by saboteurs as well as for local emergencies resulting from cyclones, earthquakes and floods.

It is reported that some municipalities have held joint conferences of their fire, police, street and sewer departments along with officials who direct water, electric, gas, telephone, street car and sim-

This Check List will help you buy PERMANENT insulating effectiveness

FOR any insulating material to provide maximum fuel or refrigeration savings . . . *and keep on providing them, year in, year out* . . . it must stand up under careful checking with the list at the right. If the materials you are now using do not meet these requirements, you can select a Johns-Manville Insulation that does.

LOW CONDUCTIVITY	This, of course, is the first thing you look for in insulation. Because Johns-Manville Insulations provide lowest conductivity consistent with strength and other essentials, they assure initial high fuel savings that continue throughout years of service.	✓
TEMPERATURE RESISTANCE	To maintain its original effectiveness, the insulation you use must remain unaffected by the temperatures to which it is subjected. From the complete line of J-M Insulations, you can select the right material for any temperature from 400° F. below to 2500° F. above.	✓
CRUSHING STRENGTH	In locations where it is subjected to compressive loads, the insulation must be able to maintain its strength and true form, even while heated to service temperatures. For such services, the J-M line offers insulating materials with unusually high load-bearing capacities.	✓
BREAKING STRENGTH	Resistance to breaking is important in guarding against damage during transportation and installation. Certain services also demand more than ordinary toughness in insulations. Many J-M materials have unusually high resistance to breaking, as measured by transverse strength.	✓
FULL THICKNESS	For maximum insulating protection, the insulation you use must not sag or compress during application, or deteriorate in service. J-M Block and Pipe Insulations are designed to avoid such dangers . . . and they can be applied without risk of voids or thin spots.	✓
MOISTURE RESISTANCE	This feature is particularly important in refrigeration service, since moisture infiltration causes most low-temperature insulation failures. J-M Refrigeration Insulations offer unusual moisture resistance, and, because of their basically mineral composition, are rotproof and verminproof as well.	✓
STABILITY IN SERVICE	If maximum fuel or refrigeration savings are to continue indefinitely, the insulation you use must not only possess the above characteristics at the start, it must retain them throughout the life of the equipment on which it is used. The column at the left gives some brief facts on a few of the many J-M Insulating Materials.	

Check the Characteristics of these J-M Insulating Materials

H-T SUPEREX BLOCKS. For many years the most widely used block insulation for temperatures to 1900° F. Combines high heat resistance and low thermal conductivity. Furnished 3" to 12" wide; 18" and 36" long; from 1" to 4" thick.

L-W SUPEREX BLOCKS AND PIPE INSULATION. New-type Superex Block and Pipe Insulation for temperatures to 1500° F. Light in weight, high in insulating efficiency, unusually resistant to compression and breaking. Pipe Insulation in all sizes. Blocks same sizes as H-T Superex.

ASBESTO-SPONGE FELTED SHEETS AND PIPE INSULATION. For temperatures to 700° F. where maximum efficiency, salvage value and resistance to vibration and abuse are essential. For outdoor lines, pipe insulation furnished with waterproof jacket. Sheets 6" to 36" wide; 36" long; ½" to 4" thick. Pipe Insulation in all standard sizes.

J-M 85% MAGNESIA BLOCKS AND PIPE INSULATION. Long recognized as the standard material for temperatures to 600° F. Maintains its high insulating efficiency through years of service. Blocks 3" to 12" wide; 18" or 36" long; 1" to 4" thick. Pipe Insulation in all standard sizes.

J-M ROCK CORK SHEETS AND PIPE INSULATION. For cold-storage rooms, refrigerated equipment and piping. Basically mineral, it can't rot, won't harbor vermin or support mold. Highly moisture-resistant, stays permanently efficient in service. Sheets 18" wide; 36" long; 1½" to 4" thick. Also furnished as lagging and pipe insulation.

SIL-O-CEL C-22 BRICK. Insulating refractory for temperatures up to 2000° F. Heat-storage capacity less than ⅓ that of firebrick; is 3 to 4 times more effective in preventing transmitted heat loss. Crushing strength—700 lbs./sq. in. Standard firebrick sizes and shapes.

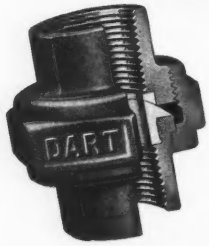
JM-20 BRICK. New-type insulating-refractory brick for temperatures up to 2000° F. Unusually light in weight (1.9 lbs. per standard 9" equivalent). Standard firebrick sizes and shapes.

FOR DETAILS on the complete line of J-M Insulating Materials, write for Catalog IN-55A. Johns-Manville, 22 East 40th St., New York, N. Y.

Johns-Manville INDUSTRIAL INSULATIONS

For every temperature . . . for every service

COMPARE A DART



with any other union

Check Dart features, point by point, and just see if you can match them in any other union. Notice the spherical shape of Dart's two bronze seats . . . Notice that they're precision ground. This exclusive "true-ball" joint means quick, sure tightness in installation—longer, leak-proof service. Notice, too, the sturdiness of the body and nut. They're made from air refined malleable iron—a metal proved to have low stretch and high resistance to hard knocks . . . Dollar for dollar, you'll get maximum service in Darts.

DART UNIONS

E. M. DART MFG. CO.,
PROVIDENCE, R. I.

Sales Agents: The Fairbanks Company, New York, and all branches. Canadian Factory: Dart Union Company, Ltd., Toronto, Canada

ilar services, but many cities have not yet organized for defense or emergencies. Many organized groups meet daily or weekly.

Among the precautions taken are to: Examine every member of the personnel of these services. Eliminate people of doubtful national loyalty and develop intense company spirit. Watching for suspicious acts or persons. Develop reserve and independent units which can be operated if the main system breaks down from any cause. Use protective lighting equipment for emergency at key points. Install reserve pumping units for water, and similar emergency equipment for other public services. Assign the most trustworthy man in each department to defense and emergency protection and keep him free for such tasks. Act now to protect plants and service against "crackpots". Prepare for quick shut-offs, substitute supplies and the like.

Economic Effects of Government Buying

NORMAL activity in all industries today has been interrupted by the National Defense Program that is being pushed as rapidly as possible to a full war basis. In no industry is the immediate effect more noticeable than in the production of steel ingots, plates and structural shapes. What has happened to business practices in this industry will in a short time, if it has not all ready done so, be at least partially paralleled in all other industries. Edwin B. George, economist, Dun & Bradstreet, Inc., analyzed the effect of Government buying on industry before the recent annual convention of the American Institute of Steel Construction in which he drew attention to practices which should be watched with extreme care. He said, in part:

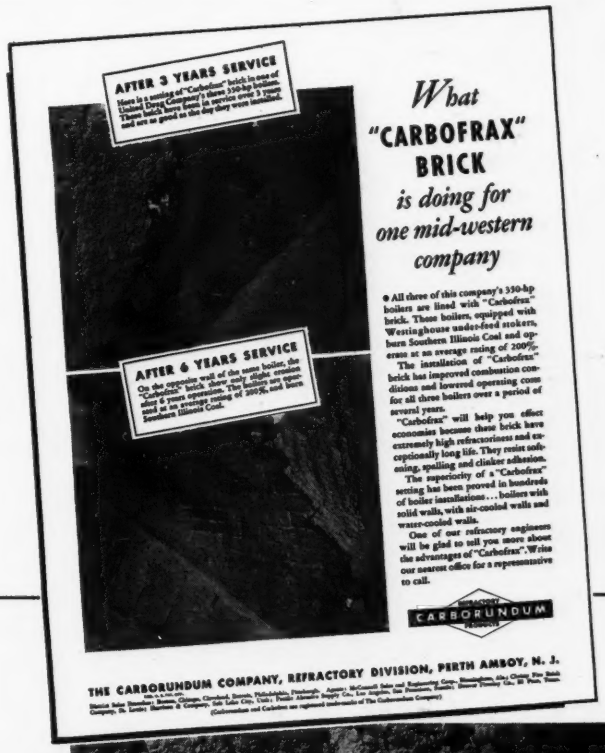
Among many self-evident truths supporting our re-armament program, two stand out. First, in a world of violence, a nation with our stake in life must protect it. Second, no country can throw ten to fourteenth billion dollars into miscellaneous, unproductive activities without something happening to its financial structure, its standard of living, and even its many self-indulgences which perhaps, just conceivably, it would never relinquish except in the purifying heat of crisis.

Rebuild America

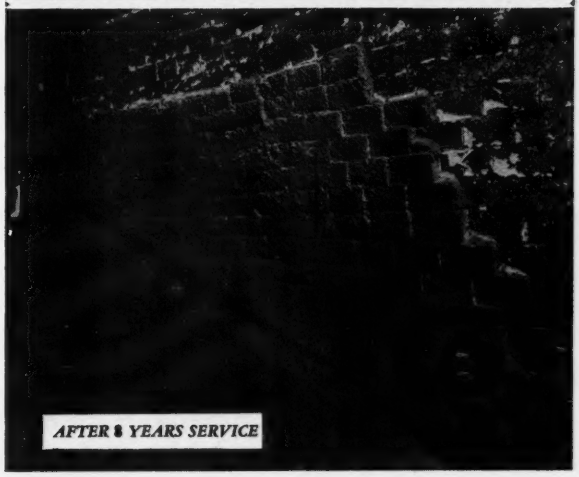
What we will really be doing in our present frantic effort to keep pace with events is to rebuild a part of America. Some degree of strain and distortion will eventually follow the slapping down of twenty billions of new money on the economic bric-a-brac that we fondly think of as an economic system. We have had a fateful lesson from France and other continental victims of force that civilian morale is one of the keynotes of any defense program. For obvious reasons, therefore, the Defense Commission is straining every nerve to minimize the economic dislocations resulting from its own violence.

The country has to keep on living. One of our practical objectives therefore must be to make maxi-

We had a Good Story then →


AFTER 3 YEARS SERVICE
AFTER 6 YEARS SERVICE
What "CARBOFRAX" BRICK is doing for one mid-western company
THE CARBORUNDUM COMPANY, REFRACTORY DIVISION, PERTH AMBOY, N. J.

. . . BUT WE HAVE A BETTER ONE NOW →



NOTE the replica of the advertisement we ran in October 1938. It is a story of two "Carbofrax" brick settings which showed little or no spalling, softening or effects of clinker adhesion after three years and six years respectively. But now we have improved upon that story, for here are unretouched pictures of these same two walls after five years continuous service for one and eight years for the other. There is so little difference in the two walls now that here again is ample proof of the truly remarkable refractoriness, the exceptional long life of "Carbofrax," the Carborundum Brand Silicon Carbide Refractory. In fact these linings look good for several more years of service. A "Carbofrax" setting is certainly a dependable setting.

CARBORUNDUM

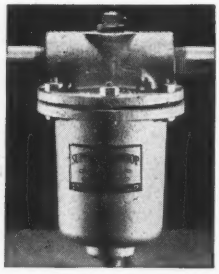
THE CARBORUNDUM COMPANY
REG. U. S. PAT. OFF.

Refractory Division, Perth Amboy, N. J.

District Sales Branches: Chicago, Philadelphia, Detroit, Cleveland, Boston, Pittsburgh. Distributors: McConnell Sales and Engineering Corporation, Birmingham, Ala.; Christy Fire Brick Company, St. Louis, Mo.; Harrison & Company, Salt Lake City, Utah; Pacific Abrasive Supply Company, Los Angeles, San Francisco, Calif.; Denver Fireclay Company, El Paso, Texas; Smith-Sharpe Company, Minneapolis, Minn.

(Carborundum and Carbofrax are registered trade-marks of and indicate manufacture by The Carborundum Company)

Straight-line trapping *STOPS "DETOUR" PIPING*



● Straight-line piping of inverted bucket steam traps signalizes the end of wasteful, time-consuming "Detours." Such waste is no longer necessary—the modern Anderson Super-Silvertop design makes "detour" piping out of date. This engineered steam trap simplifies the trapping, for piping with Super-Silvertop is quick—saves fittings and labor—is neater in appearance. Installed either straight-in-line or as an elbow, Super-Silvertop requires no extra fittings and you save as much as an hour of installation time per trap.

The guided, bucket-on-a-trap design of Anderson Super-Silvertop steam trap insures constant, perfect parts alignment. Longer lever arm gives greater condensate capacity and trap is easily inspected without disturbing pipe connections.

Get the complete story—send for your copy of "How To Choose a Steam Trap"—write to—

THE V. D. ANDERSON CO.
1939 West 96th Street • Cleveland, Ohio

Super-Silvertop Steam Traps

mum use of our industrial resources, not merely as to productive capacity but also as to industrial manpower. After military considerations are served, unemployment statistics may be expected to influence many of the government's decisions on the distribution of orders and the location of new plants.

The same means that we have created for building defenses have in them elements of flexibility that can help to minimize their social cost. After they have served their proper military purposes, there will remain a residue of power that can be turned either to the negative task of repairing their own damage or the positive one of easing some of our chronic ailments.

In negotiated contracts, an innocent-looking phrase, is packed a surprising amount of power for the pushing of economic consequences in one direction or another. Again, when the administration decides that some materials are "strategic", some "critical", and some "essential" they will to some inscrutable extent be altering people's lives in the affected areas of importation, production and distribution. A thoughtless and "just in case" system of freezing normal business in many of these materials could easily be more costly than productive. Still further, exercise of the priority power interrupts whatever trend may have been in process in the industries accelerated and the industries retarded. But, if used carefully, the bruises it leaves can be kept minor and in some instances, it can be made to produce intended as well as chance economic results.

The partial replacement of competitive bidding by negotiated contracts does not mean that sellers and buyers may now expect to live to a serene and untroubled old age, nor that the economic results will all be good. An automatic system is being replaced by a discretionary one and where there is discretion there can be differences of opinion and friction. Furthermore the purchasing authorities will sacrifice the protection now enjoyed against pressure from many sources, whether political, industrial, or labor. The potentialities of conflict seem to sum up as follows: Buying flexibility in the interest of full utilization of resources vs. exposure to economic pressures and prejudices.

Price Policies

In the new setting there has been almost none of the old NRA friction between factions trying to control price and those trying to set it free. In the first place everyone concerned is moved by a common and sobering purpose. The maneuvering limits are much shorter, for the urgency of the need keeps most arguments on relatively short tether. Secondly, the government's official price guardians are laboring over threats to price stability that come out of the government's own actions, and not out of industry's grievances against what it once regarded as competitive excesses. And finally, as the "guardians" themselves acknowledge, business is much more aware of the importance of price policy than it was ten years ago. Particularly in an emergency such as the present, it has more dead reckoning marks to go by. It can look

Story of the Chief Engineer who

Hated to Work on Sunday!

Find Out How to Protect Your Steam Power Plant Equipment from Scale, Corrosion, Carry-over . . . with Allis-Chalmers AKON Feedwater Service!

"YES SIR! I like to spend Sundays with my family. But being a Chief Engineer, I've always had to reserve my Sundays for possible work at the plant — cleaning out boiler tubes plugged with scale . . . repairing corroded parts . . . replacing rotted gaskets or pump packing . . . correcting carry-over troubles that clean feedwater would have avoided.

"It was to save my Sundays that I investigated the AKON feedwater service. In fact I dumped the whole responsibility into their lap.

"It was one of the smartest moves I ever made . . .

"AKON Licked Our Feedwater Problems!"

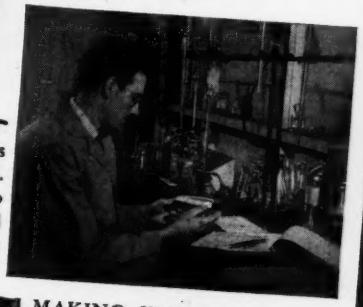
"Not only did it give me back my Sundays . . . but AKON service actually licked our feedwater problems. Scale, corrosion, carryover — these are things of the past with us. And the cost of AKON service has been minor compared to the repair and maintenance costs we formerly had.

"Take a tip from me — look into the AKON service . . . find out how it does the *whole job* of protecting you from the dangers of impure steam and improperly treated feedwater.

"If you write Allis-Chalmers, Milwaukee, they'll be glad to give you the same information and help they gave me. And believe me—it pays!"

A 1255

WHEN YOU, AS A PROSPECT for a modern feedwater treatment, ask for information about the Allis-Chalmers AKON Service, our first step is to find out what your problem is. A trained AKON Field Service Engineer visits your plant . . . studies conditions . . . takes samples for preliminary study.



YOUR SPECIFIC FEEDWATER problem is analyzed in the Allis-Chalmers laboratory by expert feedwater engineers. The resulting prescription is designed to prevent scale, corrosion, carry-over, and other boiler ills in *your* plant . . . with provisions for meeting changing conditions.

MAKING SURE THAT AKON equipment is correctly installed and its use fully explained to your engineers, is an important part of the AKON Service Man's job. Here an AKON Service Man explains an AKON Conductivity Meter, showing the condition of the steam at all times.

VITAL TO AKON'S SUCCESS IS the part played by the AKON Field Service Engineer in your territory who makes frequent, unsolicited calls in your plant . . . inspects your equipment . . . makes repeated tests of water and steam . . . helps you get complete feedwater protection!

Over 90 Years of Engineering Superiority Work for You When You Specify Allis-Chalmers!

ALLIS-CHALMERS

MILWAUKEE · WISCONSIN

Modernize and Economize

with

WARE HI-LAG FUSES

Start your plant economy program around the improved WARE HI-LAG Fuses.

The exceptionally high time lag of WARE HI-LAG Fuses ends the blow-outs often caused by starting motors and momentary surges.

The new double-bridge, self-aligned assembly used on these WARE HI-LAG Fuses is easy to renew and insures extra strength and longer life. Assembly may be inserted either end first.

WARE HI-LAG Fuses are Underwriters approved; give 100% protection to your circuits; soon pay their cost through saving of lost time. Write for our Trial Test Offer, sizes and prices.

WARE BROTHERS

4500 W. Lake St. **Chicago**

back to the years 1916 to 1922 and of its own accord prefer price stabilization.

Despite outcries over its supposed self-enrichment in the last emergency, its private feeling is that artificially stimulated price booms are more notable for their hangovers than for the fun they afford. The reasons are many. That much of what went up came down is one of them. And at any point in the process prices also became costs. Violent price spirals have firmly registered in many executives' minds as something to be dreaded, and by the same token there is little eagerness to be responsible for them. This may be industrial statesmanship or it may be merely a long memory. There may in fact be little distinction between the two. But whatever the reasoning, the current crop of price protectors and profit seekers actually conducting the nation's business are so far not complaining very much about each struggle with the peculiar realities of the emergency. At any rate narrow attitudes are not to date, on either side, one of our bottlenecks.

Industry Promoting Research

GIFTS and grants to a total amount of $38,855 have recently been offered to the University of Wisconsin and accepted by the Board of Regents. Contributions ranged in amount from $30 to $12,500 and came from 18 different sources throughout the country including alumni groups, research and industrial organizations.

For the home economics practice house on which construction has been started, the Wisconsin Utilities association gave a grant of $12,500 in addition to a previous initial gift of $20,000 for this house.

Five gifts were earmarked for student loan and scholarship funds. Among others were fellowships in specific lines of research for which the university is particularly well equipped.

Glass for Concrete Reinforcement

GLASS to reinforce concrete beams as a substitute for steel sounds like a phantasy. But Engineering of London gives the results of investigation by Messrs. A. W. Soden and J. A. Lincoln and tests by Dr. W. S. Marshall which indicate that it may be possible at any rate to save steel in the face of war demands.

Glass used is ordinary fire finish with cut top edges and rounded lower edges, imbedded in the lower part of concrete beams from a little above the bottom to somewhat over half the depth from the bottom. Thickness of glass strips should be 0.28 of the spacing between strips or spacing should be twice the glass thickness. In the tests, beams 12 in. wide by 4½ in. deep were used, the glass strips being $\frac{5}{16}$ in. thick by 2¼ in. deep, set in con-

THIS is a picture of a rotor from a Fairbanks-Morse Motor

Notice the squirrel cage winding!

It is of copper. The *one* metal most desirable, electrically and mechanically, for meeting the severe service a modern motor must withstand. Copper, the *one* metal of low resistance and low thermal expansion—best able to withstand high temperatures caused by constant plugging and reversing service.

Note further that this copper is *centrifugally cast* into a one-piece winding. *Centrifugally cast* to imbed the winding into the core slots deeply and tightly.

Then, after casting, this rotor is machined and dynamically balanced to the famed Fairbanks-Morse standards of precision.

Only Fairbanks-Morse makes rotors with copper windings which are centrifugally cast. The Copperspun Rotor is an exclusive Fairbanks-Morse development, process, and feature.

For complete information on F-M Motors with Copperspun Rotors, write Fairbanks, Morse & Co., 600 S. Michigan Avenue, Chicago, Ill. Branches and service stations throughout the United States and Canada.

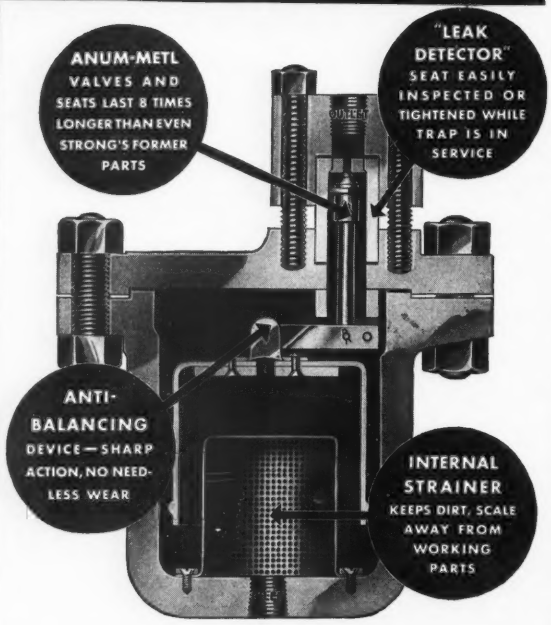
7708–EA40.153

FAIRBANKS·MORSE MOTORS

DIESEL ENGINES ELECTRICAL MACHINERY RAILROAD EQUIPMENT WASHERS-IRONERS STOKERS
PUMPS FAIRBANKS SCALES WATER SYSTEMS FARM EQUIPMENT AIR CONDITIONERS

PIPEWRENCH PETE SAYS:

WHEN YOU'RE HANDLING SUPERHEAT, GET ALL 4!


ANUM-METL VALVES AND SEATS LAST 8 TIMES LONGER THAN EVEN STRONG'S FORMER PARTS
"LEAK DETECTOR" SEAT EASILY INSPECTED OR TIGHTENED WHILE TRAP IS IN SERVICE
ANTI-BALANCING DEVICE—SHARP ACTION, NO NEEDLESS WEAR
INTERNAL STRAINER KEEPS DIRT, SCALE AWAY FROM WORKING PARTS

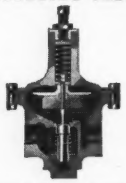
97% PERFECT TRAPS WASTE BIG MONEY!

High pressure traps better close tight or 300 to 1,400 pounds builds up waste fast! Worst part is, leaks may not be discovered for weeks!

Play safe with STRONG Forged Steel Traps whose 4 unusual features insure *100% performance.* With these features, plus stainless buckets and wear-proof parts, they cost little to maintain in the perfect condition you need.

No wonder so many of the new high pressure plants specify STRONG Forged Steel Traps! They're a real buy. Investigate them, and STRONG'S *complete line* of steam specialties. Every item offers moneysaving advantages! Send for Catalog 63-PE3.

MODERATE-PRICED REDUCING VALVE



For initial pressures to 160 lbs., reduced to 85 lbs. or less, use STRONG Type K Reducing Valves. Trouble-free design. Anum-metl seats and discs guaranteed one year! Get bulletin 154-P3.

The Strong, Carlisle & Hammond Company
1392 West Third Street, Cleveland, Ohio

STRONG
STEAM SPECIALTIES

crete with a 1:2:3 mix, ballast being ¾ in. diam. In these the strips were set flush with the bottom and a wetter mix used for the lower half of the beams to aid in compacting the cement between strips.

Results showed first cracks at bending moment of 56,000 to 57,000 in.-lb. when 10 strips were spaced 1⅛ in. pitch and 34,500 to 43,800 in.-lb. with 6 strips, pitch 2 in. Moments at failure were about 64,000 in.-lb. for 1⅛-in. pitch and 45,000 in.-lb. for 2-in. pitch. Thus failure occurs so soon after the first cracks as to be sudden, no delay as in steel reinforced beams. Deflection at ⅓ failing load was negligible. The designed safe moment showed a factor of safety of 2.3 to 2.4.

Impact tests by dropping a 16-lb. ball 6 ft. showed cracking of the glass strips, although the concrete surface was not damaged.

Dr. Marshall concludes that for static loading, with pitch less than 2 in., the glass is a good substitute for steel, but it should not be used where there is likelihood of impact shocks.

Air Conditioning Installations

IN a recent survey of air conditioning made by the Edison Electric Institute, it is revealed that more than 42,000 installations, are served by 183 utility companies. One-fourth of these installations are in offices and office buildings; one-fifth are in restaurants and retail stores; one-fifth are in apartments. The remainder are scattered among nearly two dozen classifications which include banks, barber shops, beauty parlors, broadcasting stations, hospitals, hotels, funeral homes, department and drug stores, theaters, fur storage plants and many kinds of manufacturing plants.

Many industrial plants have found air conditioning an important factor in successful operation, reports the New Jersey Public Utility Information Committee. In the data on air conditioning thus far assembled are records of thirty different kinds of business classifications.

SUITABLE for use as a heating and cooling transfer medium for industrial temperatures up to 900 deg. F., a new chemical mixture was described in a paper presented recently before the A.I.C.E. by three du Pont men, Dr. W. M. Nagle, W. E. Kirst and J. B. Castner.

The material consists of approximately 40 per cent sodium nitrite, 7 per cent sodium nitrate and 53 per cent potassium nitrate. The melting point is low, heat transfer rate high, with good thermal stability and low corrosion action. The solid material in salt form melts at 288 deg. F. and when molten can be pumped like water. According to the paper, is requires 48 air pipes with 1700 times the theoretical power requirements to transfer the same amount of heat as one pipe handling the molten salt.

Are you paying a 10% tax on pumps that belong to the past

?

When pumps turn power-hogs, watch out for costs. Even small power leaks quickly run into big money, frequently as much as 10% of your pump power consumption. You can stop these losses by careful checks on pumping costs and an intelligent replacement program with Warren Pumps . . . When should an inefficient pump be replaced for maximum savings? Warren engineers can help you answer that important question, analyze individual pumping records, uncover inefficiencies, and make specific recommendations for pump replacements that will pay their way . . . A new catalog, covering the complete line of Warren Pumps, is available on request.

WARREN PUMPS

Warren Steam Pump Co., Inc., Warren, Mass.

7937

New Engineering Books

Practical Mathematics. By Glenn M. Hobbs, James McKinney and J. Ralph Dalzell. Second Edition. Published by the American Technical Society, Drexel Ave. at 58th St., Chicago, Ill. Size 5½ by 8½ in., 599 pp.; cloth bound. Price $2.40.

Practical mathematics is a popular and appealing topic which unfortunately seldom lives up to its name. Books of this type upon close examination are usually found to be either conventional text books, lacking any semblance of practical application, or a miscellaneous collection of short cut formulae without the fundamental and logical background so essential if mathematics is to be used as a tool.

This is one book that we can recommend without qualification for beginners and for those who have forgotten and want to re-learn the fundamentals with a minimum of time and effort. It is devoted entirely to the phases of mathematics as used most widely in trade or applied branches of engineering such as addition, subtraction, multiplication, division, factoring, fractions, decimals, percentage, powers, roots, ratio, proportion, equations, formulas, graphs and logarithms. In connection with the latter there is a five place logarithmic table covering numbers from 1 to 999.

The second edition of the book has been largely rewritten and in addition, time tested in over a year's use in pamphlet form by home study students. Illustrative examples are worked out step by step with an explanation of each step. The problems are directly concerned or taken from various phases of engineering so that the student learns the importance of the application of these progresses in practical everyday life, at the same time he is becoming familiar with the mechanical mathematical processes.

In addition to mathematics proper there are included a large number of tables of useful information covering common weights, measures, etc. The illustrative problems worked out are supplemented by suggested and examination problems, the answers to all of these being given in the back of the book.

Metal Sensitivity of Steam Turbine Oils by James I. and Marion G. Clower is the title of a 22 pp. book recently published by the Engineering Experiment Station of the Virginia Polytechnic Institute, Blacksburg, Va. It is known as Series No. 46 and nominally sells for 25 cts. a copy, although a limited number of copies are available for free distribution. The bulletin discusses emulsification, oxidation and foaming together with laboratory tests to determine the effect of different metals on these properties. Investigation indicates that a longer useful life of steam turbine oils may be secured by consideration of the oil characteristics with the metals found in the oiling system. However, the relations must be established by actual service tests or laboratory tests for each particular installation and for each brand of oil.

Progress of Preparedness by Leonard P. Ayres, Vice President, is being distributed by The Cleveland Trust Company, Cleveland, Ohio. This is a 27 pp. pamphlet to answer the question: How long will it take us to reach a condition of military preparedness? Basic reference used is the rate of progress made 23 yr. ago in the World War under somewhat similar conditions. This past record is interpreted in relation to present conditions, time factor, public coöperation, civilian participation, etc.

Concrete Design and Construction. By W. Herbert Gibson and Walter Loring Webb. Published by the American Technical Society, Drexel Ave. at 58th St., Chicago, Ill. Size 5½ by 8½ in., 492 pp.; cloth bound. Price $4.75.

Concrete has in a comparatively short time become one of the essential construction materials, with a wide range of use and application. This book supplies information needed by the engineer and contractor interested in the design and use of concrete and reinforced concrete. It covers the

STAY ON TOP OF STEAM DEMAND
ALL THE TIME!
Order Now
Champion keeps the gauge needle right on the pin! It responds quickly to demand for a high or low burning rate, because it's scientifically cleaned, sized and prepared to suit your equipment and load conditions. That's why you're bound to get maximum evaporation per pound of coal when you use Champion!
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PITTSBURGH COAL CO. of Wisconsin, Duluth, Superior, Minneapolis, St. Paul MILWAUKEE-WESTERN FUEL COMPANY, Milwaukee, Wisconsin

question of: concrete properties; fireproofing qualities; reinforcing steel; design of slabs, plain beams and T-beams, explained and illustrated by fully worked out problems; columns and footings; plain and reinforced retaining walls: and the mixing, transporting and placing of concrete. An additional feature of the book is a 12 pp. section dealing with problems and questions pertaining to concrete design and construction, the questions arranged according to chapter numbers. Both authors are consulting engineers and Mr. Webb was formerly Assistant Professor of Civil Engineering at the University of Pennsylvania.

Arc Welding. Published by the Hobart Brothers Co., Troy, Ohio. Size 5½ by 8 in., paper cover; 218 pages. Price 50c.

This book, dealing with practical lessons in arc welding, is an excerpt from Part II of the large Hobart book, "Arc Welding and How To Use It." Fully illustrated, this book covers manipulation, welding and cutting with bare and coated electrodes and welding light gage steel.

Working Stresses. By Joseph Marin. Published by Rutgers University Press, Brunswick, N. J. Size 5 by 8 in.; 39 pp.; cloth bound. Price $1.00.

This is a book covering the fundamental selection of correct working stress values for the design of a structure or machine so as to obtain a safe and economical construction. It covers static loads of different types, fluctuating loads, and what is becoming of increased importance in the engineering field working stresses for creep conditions with due consideration for corrosion and deterioration. The treatment is mathematical but the explanations are clear and concise and well illustrated by mathematic drawings and graphs. The book deals principally with the effect of combined stress or state of stress on the failure of a material, a factor which greatly influences practical working values.

Punched Card Methods in Scientific Computation. By W. J. Eckert. Published by the Thomas J. Watson Astronomical Computing Bureau, Columbia University, New York City. Size 6½ by 9½ in.; 131 pp.; cloth bound. Price $2.00.

Of recent years the electric tabulating machine utilizing, punched cards has found a wide application in science and industry. This book deals with the Hollerith System, describes the operating principles of the machines themselves and their general application and use. Particular emphasis is placed on statistical and scientific computation. A considerable portion of the book is confined to the application to the science of astronomy as used in Columbia University's astronomical labortory's named after Dr. Watson, president of the International Business Machine Corporation. The book is not a manual of operation of the various machines but is intended to enable the engineer and scientist to formulate his problem so that it can be carried out by any skilled operator.

Installation and Maintenance of Electric Motors. By E. Molloy. 5 by 8 in., 180 pages, illustrated, cloth. Published by Chemical Rubber Co., Inc., New York, N. Y., 1940. Price $2.00.

This is a practical treatise for installation engineers, plant engineers and electricians. It gives the practical information necessary to enable motors to be installed successfully and maintained in good working order. The first half of the book covering Chapters I to III is devoted to installation problems and the second half, Chapters IV to VI deals with maintenance. A feature of special interest is the large number of starter wiring diagrams found in the chapter headed "Wiring and starting electric motors."

Practical Design of Small Motors and Transformers. By E. Molloy. 5 by 8 in. 176 pages, illustrated, cloth. Published by Chemical Rubber Co., Inc., New York, N. Y., 1940. Price $2.00.

This little book explains clearly the practical methods to be employed in designing and constructing small electric motors and small power transformers. Its purpose is to provide in a convenient form sufficient data to enable any engineer to undertake the design, construction and rewinding of small motors and generators and the design and construction of small power transformers for a wide variety of purposes. It presents the actual facts relative to the design of such equipment in a way that will make an instant appeal to the practical man.

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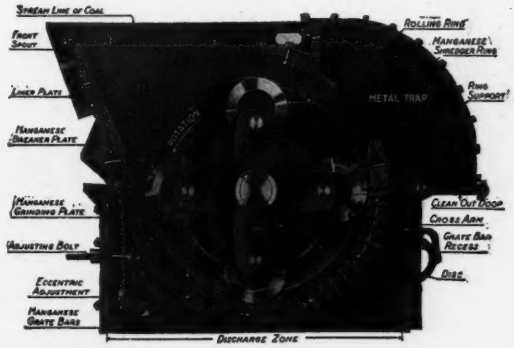

Above: Cross-sectional view of American Ring Crusher. Right: Patent shredder rings split coal in uniform size instead of crushing it—a patented "American" feature.

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Power Plant Construction News

Ala., Sheffield — Reynolds Metals Co., Federal Reserve Bank Building, Richmond, Va., plans installation of electric power equipment in new aluminum mill in vicinity of Sheffield, where site is being secured. Plant will comprise several large units for processing bauxite ore. All equipment will be electrically-operated and contract for power supply has been made with TVA. A power substation will be built at plant site. Entire project will cost about $15,000,000. Company has arranged for loan from RFC to carry out project.

Ariz., Tucson — War Department, Washington, D. C., plans power house at new army air corps base on site adjoining airport at Tucson, for First Bombardment Wing Headquarters, 41st Bombardment Group. Entire project will cost $1,250,000 including shops, headquarters buildings, barracks, utilities, etc. Appropriation in that amount has been authorized.

Calif., Burbank — Aircraft Accessories Corporation, 5210 San Fernando Road, Glendale, Calif., plans installation of electric power equipment in new plant on 7-acre tract of land at Olive Avenue and Lake Street, Burbank, recently acquired, with initial floor area of about 40,000 sq. ft. Cost reported over $150,000. Proposed to begin work soon.

Conn., Devon—Connecticut Light & Power Co., Waterbury, Conn., has approved plans for expansion and improvements in steam-electric power plant at Devon, including installation of new 43,000-kw. turbine-generator unit and auxiliary equipment. Cost reported over $3,500,000. Award for generator has been made to Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.; contracts for other equipment will be placed soon.

Ind., Anderson—Board of Public Works has plans for expansion and improvements in municipal power plant, with installation of new 1200-hp. boiler unit, superheater, economizer and auxiliary equipment. Cost estimated close to $300,000. Work will begin at early date. Russell B. Moore & Co., Indiana Pythian Building, Indianapolis, Ind., are consulting engineers.

Ind., Martinsville — Stokely Brothers & Co., 941 North Meridian Street, Indianapolis, Ind., manufacturers of canned food products, plan installation of electric power equipment in connection with rebuilding of branch plant at Martinsville, recently destroyed by fire. A new boiler house is proposed. Loss reported over $500,000, including machinery.

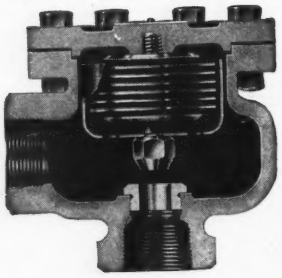
Iowa, Webster City—City Council is considering improvements in municipal power plant, including installation of new steam-generating unit and accessories. Cost estimated about $45,000. C. C. McCarthy is city manager.

Mass., Worcester—American Steel & Wire Co., Rockefeller Building, Cleveland, Ohio, plans installation of electric power equipment in four additions to branch mill at Worcester, with largest structure about 500x1000 ft. Work will be carried out in connection with a modernization and improvement program in present buildings, entire project reported to cost in excess of $2,000,000. Work is scheduled to begin soon. Carl I. Collins is manager at Worcester.

Mich., Portland—Tri-County Electric Co-Operative, Inc., Portland, has plans maturing for new electric generating station for power supply for rural electric lines and will proceed with work soon. Installation will include two 1000-hp. Diesel engine-generating units and auxiliary equipment. Fund of $175,000 has been secured through REA for entire project. Dolph Wolf is manager.

N. Y., Bethpage—Grumman Aircraft Corporation, Bethpage, manufacturer of military and other aircraft, plans installation of electric power equipment in new additions to plant, totaling about 500,000 sq. ft. of floor space. Cost reported about $2,000,000. Austin Co., 16112 Euclid Avenue, Cleve-

More for the Money



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land, Ohio, engineer and contractor, has award for design of plant and construction.

N. Y., Brooklyn—Public Works Officer, Brooklyn Navy Yard, has appropriation of $100,000 for two new boiler houses and compressor stations at yard. Work will be carried out in conjunction with an extensive expansion and improvement program now under way. Capt. John H. Broshek is industrial manager at yard.

N. Y., College Point—Edo Aircraft Corporation, College Point, plans installation of electric power equipment in new two-story addition, about 50,000 sq. ft. of floor space. Entire project will cost over $150,000. Brown & Matthews, Inc., 122 East Forty-second Street, New York, is engineer.

N. Y., Rochester—Eastman Kodak Co., Kodak Park, plans installation of electric power equipment in new six-story addition to Hawk-Eye works for manufacture of optical instruments for Federal service. Cost reported over $750,000. Proposed to begin work soon.

N. C., Franklin—Nantahala Power Co., Franklin, plans new hydroelectric power development on Little Tennessee River in section of Swain and Graham Counties, N. C., consisting of power dam, artificial lake, hydroelectric generating station of 300,000-hp. ultimate capacity, switchyard, transmission lines and other structures. Cost reported over $3,500,000. This supplements two hydroelectric stations now being built by company on Nantahala River, Macon County, N. C., and on fork of Tuckasegee River, near Glenville, N. C. Company is affiliated with Carolina Aluminum Co., Badin, N. C.

Ohio, Cincinnati—Cincinnati Gas & Electric Co., Fourth and Main Streets, has approved plans for extensions and improvements in steam-electric generating station in Columbia Park, with installation of new 65,000-kw. turbine-generator unit and auxiliary equipment. Cost reported in excess of $4,500,000. Award for generator has been made to General Electric Co., and contracts for other equipment will be placed soon. Completion is planned early in 1942.

Ohio, Hamilton — Curtiss-Wright Corporation, 30 Rockefeller Plaza, New York, N. Y., manufacturer of airplanes and parts, plans installation of electric power equipment in new branch plant at Hamilton, for production of aircraft for Federal Government. It will consist of several large units, totaling about 1,000,000 sq. ft. of floor space. A power house will be built. Entire project is reported to cost over $10,000 000. Work will begin this fall.

Pa., Philadelphia—Bendix Aviation Corporation, South Bend, Ind., plans installation of electric power equipment in new plant at Philadelphia, where company has acquired former factory of Atwater Kent Co. (radio equipment), at Wissahickon Avenue and Abbottsford Road, totaling about 640,000 sq. ft. of floor space. Structures will be improved and equipped for production of aircraft parts. Entire project estimated to cost over $3,000,000.

Pa., Port Alleghany—Contract has recently been let to the Frontier Eng. Corp. of Buffalo for a 150,000 gal. fuel oil storage tank, boilers, fuel oil burners, controls and incidental equipment for the Pittsburgh-Corning Corp. a member plant of the Pittsburgh Plate Glass Co. Details, specifications, dates and data on necessary equipment can be obtained from W. A. Ensign, V.P. in Chg. of Field Operations, Frontier Eng. Corp., Port Alleghany, Pa.

Va., Martinsville—E. I. du Pont de Nemours & Co., Inc., Rayon Division, du Pont Building, Wilmington, Del., plans power plant at new nylon mill at Martinsville, where tract of about 485 acres of land has been acquired. A pumping station will be built. Electric power equipment will be installed for mill service. Entire project will cost close to $10,000,000. Work is scheduled to begin at early date.

Wash., Bellingham—Puget Sound Pulp & Timber Co., Bellingham, plans installation of electric power equipment in new addition to unbleached sulphite pulp mill to increase plant capacity from 100,000 to 150,000 tons per annum. Cost estimated about $1,500,000. Work will be placed under way soon. Ossian Anderson is president.

Wash., Bremerton—Public Works Officer, Puget Sound Navy Yard, plans extensions and improvements in central power plant at yard, including installation of additional equipment. Appropriation of $300,000 has been authorized. Work will be carried out soon.

Wis., Elkhorn—Electric Light and Water Commission is completing plans for expansion in municipal power plant, including installation of new Diesel engine-generating units with capacity of 1800-kw., and complete accessories. Cost estimated about $175,000. Work will be placed under way soon.

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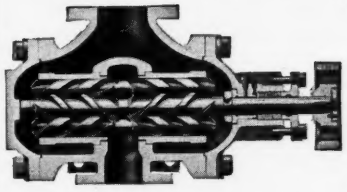
OIL PUMP
has only
3
moving parts



The central, or power, rotor and the two idler rotors are so designed that no pilot or timing gears are necessary, and the one stuffing box is that for the power rotor spindle, which is under suction pressure only. There are no valves.

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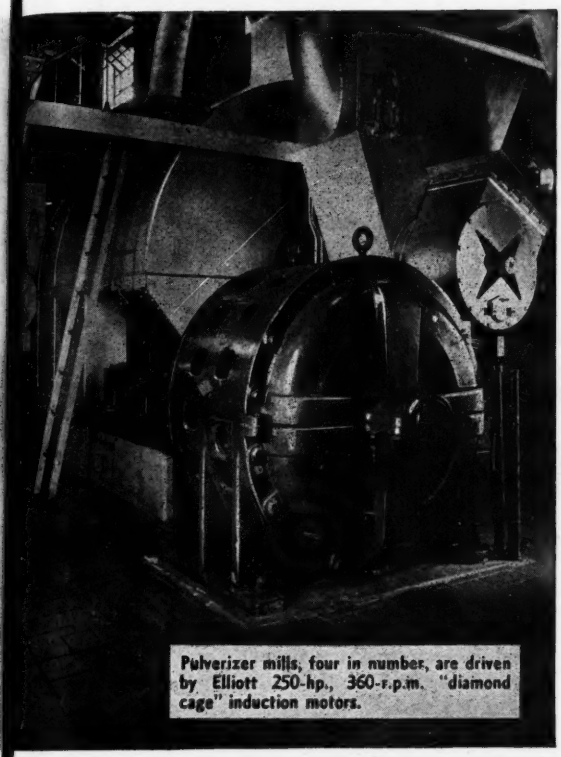

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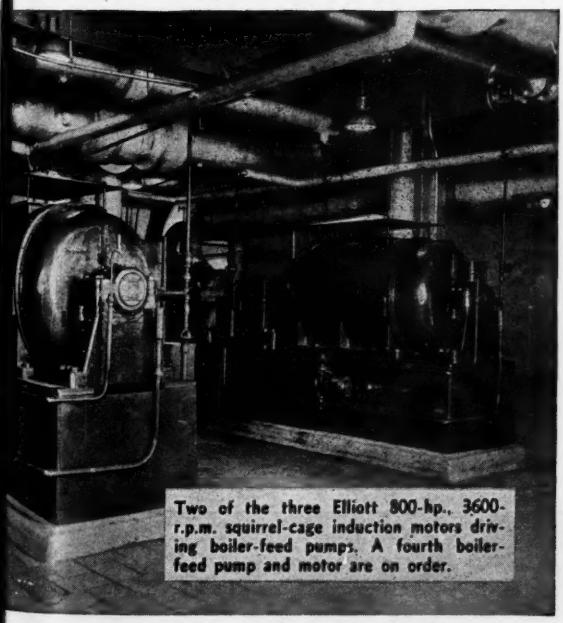

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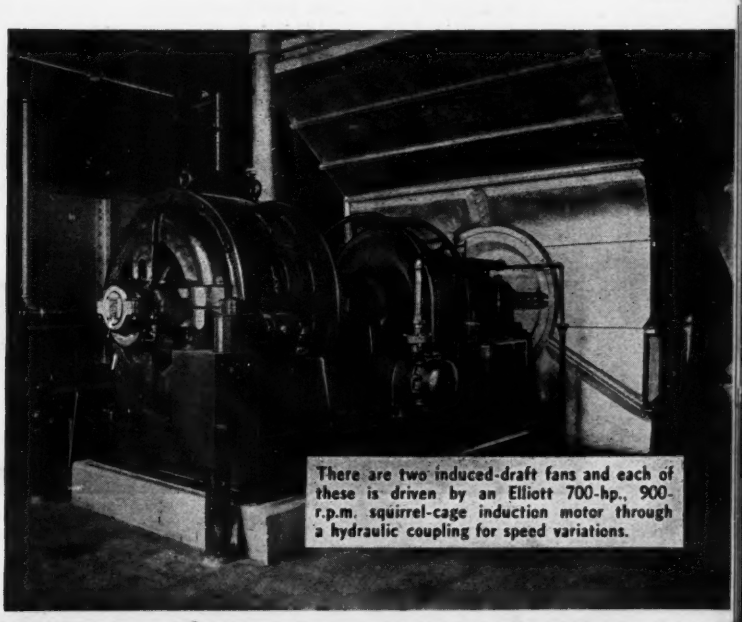

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(NO. 6 OF A SERIES)

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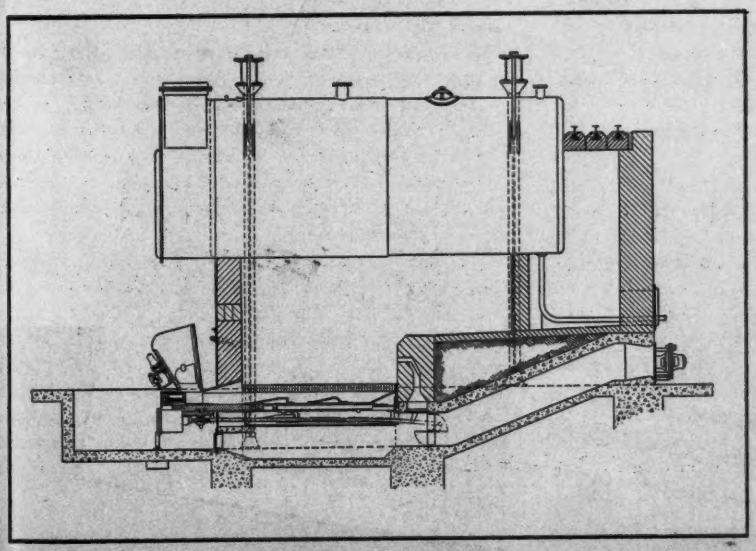

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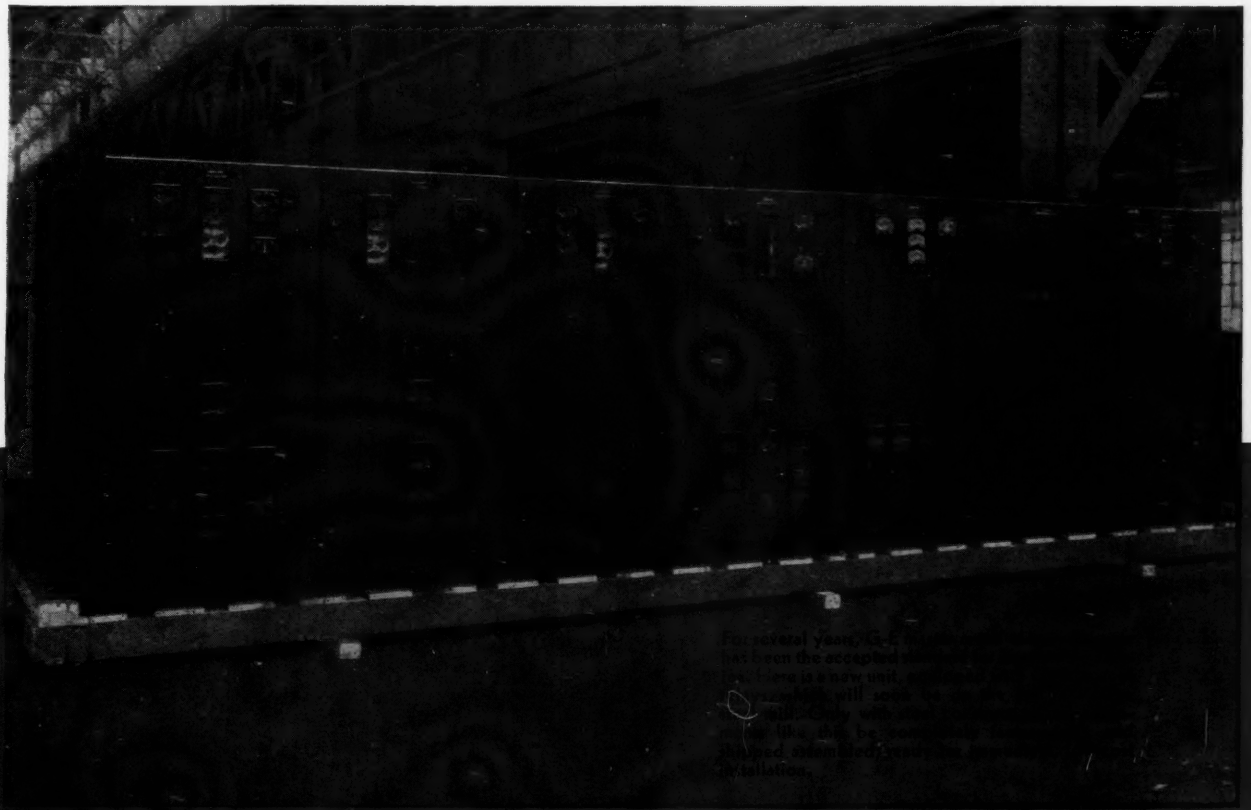
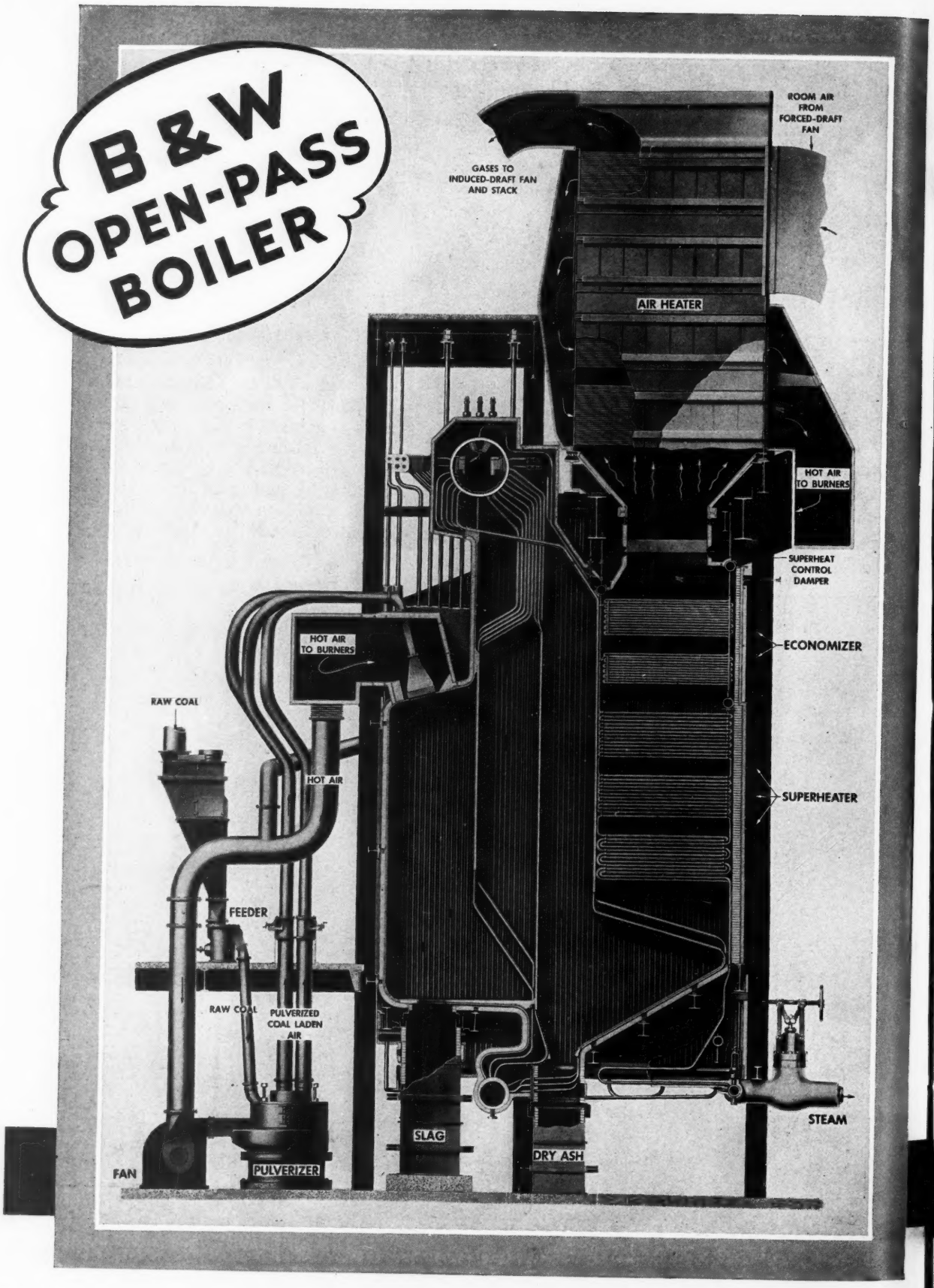


GENERAL ELECTRIC


B&W
OPEN-PASS
BOILER
ROOM AIR
FROM
FORCED-DRAFT
FAN
GASES TO
INDUCED-DRAFT FAN
AND STACK
AIR HEATER
HOT AIR
TO BURNERS
SUPERHEAT
CONTROL
DAMPER
ECONOMIZER
HOT AIR
TO BURNERS
RAW COAL
HOT AIR
SUPERHEATER
FEEDER
RAW COAL
PULVERIZED
COAL LADEN
AIR
STEAM
SLAG
DRY ASH
FAN
PULVERIZER

Ash Conditioning

By conditioning ash, the Open-Pass Boiler has made a long step forward in obtaining desirable operating characteristics with pulverized-coal-fired boilers.

The hot primary furnace with fluid ash on the walls and floor provides the ideal type of furnace for ash elimination. It also promotes stabilized combustion over a wide range of loads with coals of widely varying characteristics.

The first open-pass provides a free passage for that transition stage in which ash passes from the fluid state through a plastic, sticky state, to a dry granular form. In this section of the unit, there are no "boiler tube banks" to become fouled by the sticky ash.

The second open-pass might be termed a "dry" pass. The temperature of the ash is decreased below the fusion point of the ash, and the pass is swept clean by the downward flowing gases and gravity action of the ash. The down-flow of gases at relatively high velocity promotes uniform gas temperature across the pass without lanes of higher-than-average temperature, such as would exist with a slower, upward flow of gases in a larger chamber.

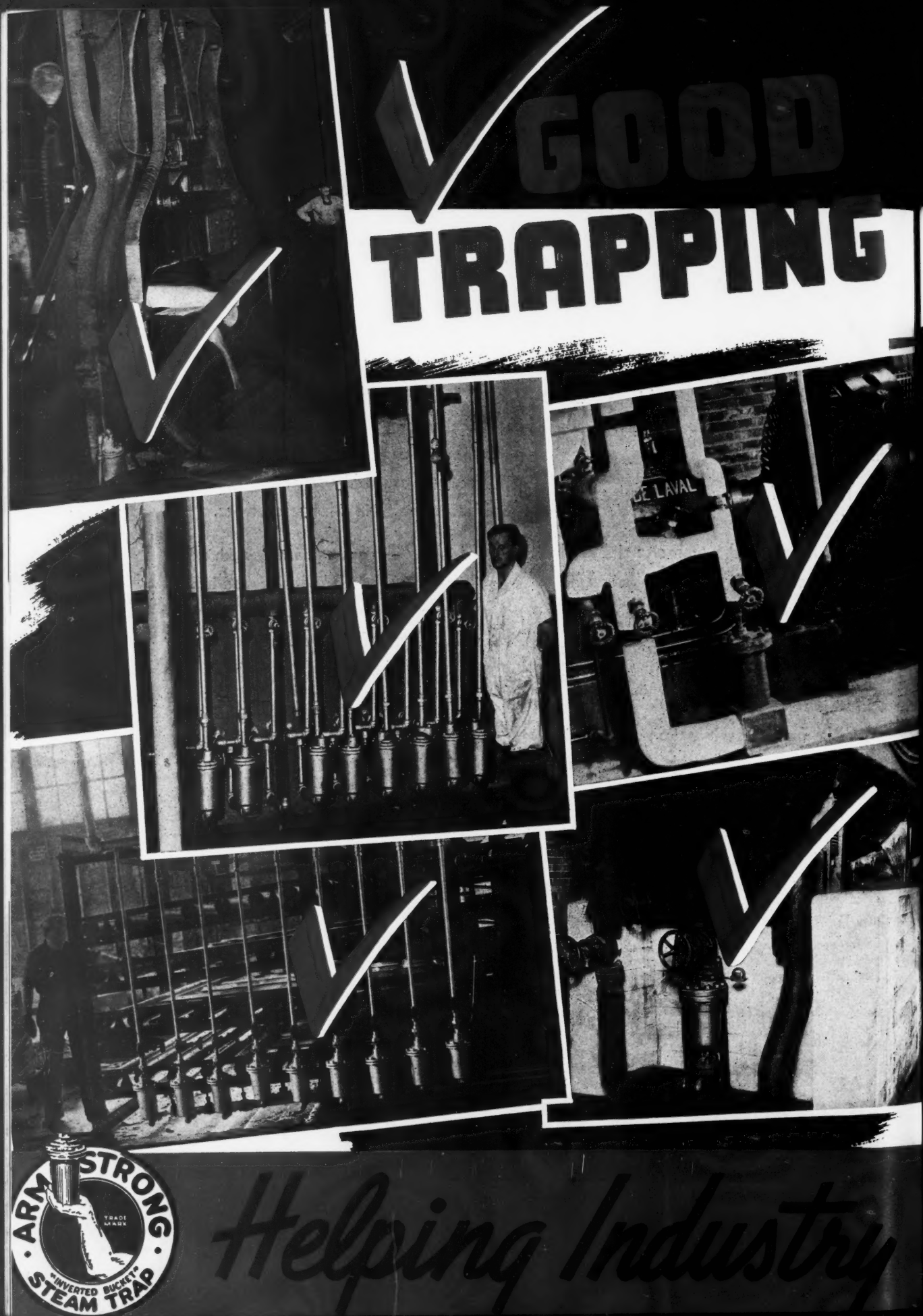
The U-turn of the gases at the bottom of the second pass, and the marked reduction in their velocity, promote deposition of dry ash in the hopper below, and further aid in securing uniform gas temperatures at this point.

At every stage in their flow through the furnace, the gases are conditioned—for better ash elimination. Furthermore, this gas conditioning minimizes fouling of the superheater, which is the first bank of tubes across which the gases pass—without lanes or zones of higher-than-average temperatures that result in sticky, tube-fouling ash.

THE BABCOCK & WILCOX COMPANY
85 LIBERTY STREET . . . . NEW YORK, N. Y.

BABCOCK & WILCOX

G-189-T


GOOD
TRAPPING
DE LAVAL
ARMSTRONG
TRADE MARK
"INVERTED BUCKET"
STEAM TRAP
Helping Industry

An *Essential* for Plants geared up to meet Defense Needs!

ARMSTRONG OFFERS *a Complete Service!*

1. THE COMPLETE TRAP. The Armstrong trap is not limited to any particular types of service. It works with either hot or cold condensate. It handles air as well as water. No steam loss at any load. Unaffected by ordinary dirt. Can stand a lot of wear without affecting operating characteristics.

2. A COMPLETE LINE. Capacities ranging from 500 lbs. to 240,000 lbs. per hour. Built for any pressure up to 2400 lbs. per sq. in. Air traps, gas traps, water traps, gasoline traps, as well as steam traps.

3. COMPLETE GEOGRAPHICAL DISTRIBUTION. Factory representatives in 42 industrial centers in United States and Canada. Traps carried in stock at 140 different points in western hemisphere.

4. COMPLETE ENGINEERING DATA. Questions concerning capacities, materials, hook-ups, operating conditions, equipment, etc., are answered in fullest detail in Armstrong data books.

5. COMPLETE SATISFACTION. All Armstrong traps are sold on a "money-back" guarantee. Write for our latest catalog. ARMSTRONG MACHINE WORKS, 810 Maple St., Three Rivers, Mich.

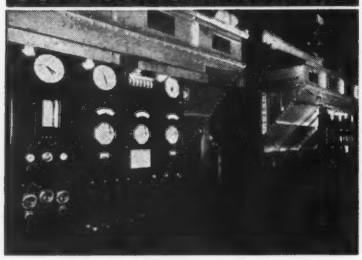
"Deliver the Goods!"

MORE POWER

TO HELP SPEED UP PRODUCTION AND CUT

Republic

COMBUSTION CONTROL



All Sizes of Boilers
All Types of Firing

Low steam costs are the result of high boiler efficiency. Daily performance at test efficiencies will result from the installation of a Republic-Smoot combustion control system. They are designed for all sizes of boilers and all types of fuel firing equipment.

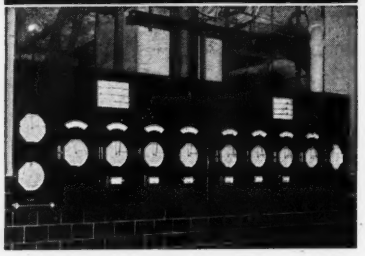
CONSTANT STEAM PRESSURE
Automatically maintains a constant steam pressure by controlling the fuel and air input to the boilers in balance with the boiler load.

EFFICIENT COMBUSTION
Automatically maintains maximum combustion efficiency over entire range of boiler rating, by controlling simultaneously the fuel and air input to boiler in measured proportions and in a fixed ratio.

LOAD DISTRIBUTION
Automatically distributes load equally among all the boilers, or the load can be distributed between the boilers as desired.

WRITE FOR DATA BOOK No. S-21

FLOW METERS



For Measuring the Flow of Steam-Water-Gas-Air-Oil

Do you have a means for easily and quickly checking the production and distribution of these power plant services? Do you know how much you are paying for steam or how economically it is being used? Republic flow meters will give you all the production and maintenance information you need in order to detect leaks and improve methods.

WORKING PRESSURES
Republic meters are available for all working pressures up to 5000 lb. per sq. in.

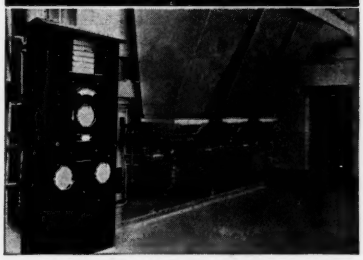
RANGE EASILY CHANGED
The range of a Republic meter can be easily and quickly changed by merely changing the range tube.

READING INSTRUMENTS
The Republic indicator, recorder and integrator operate independently of each other and can be supplied separately or in combination. They are remote reading.

EASILY READ
The indicator scale and the recorder chart all have uniform graduations and are direct reading. The integrator has a large cyclometer type dial.

WRITE FOR DATA BOOK No. 701

BOILER INSTRUMENTS



Eliminate Guesswork in Boiler Operation

Republic boiler instruments provide the operator with continuous performance records, which are the only reliable guide to efficient boiler operation.

STEAM FLOW METERS
Remote-reading indicators, recorders and integrators measure flows of steam and feedwater.

DRAFT INSTRUMENTS
Indicating and recording types in single or multiple units for all pressure or draft ranges.

CO_2 METERS
These instruments continuously indicate and record per cent CO_2 in flue gas measured by the Orsat method.

THERMOMETERS
Long-distance expansion-type thermometers with single or multiple pen recorders.

WRITE FOR BOILER METER DATA

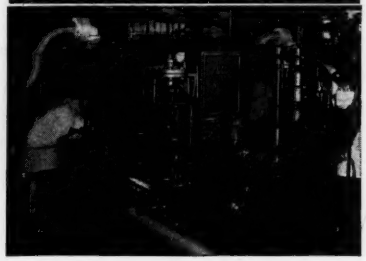
REPUBLIC FLOW METERS CO.

TO YOU

UNIT COSTS *Presents*

Visit BOOTH NO. 6 NEW YORK POWER SHOW

REGULATORS



For Controlling Pressure Flow-Level-Speed

Republic-Smoot regulators are supplied for the automatic control of pressure, rate of flow, speed of rotation, level of a liquid or the proportioning of two pressures, flows, etc., in a fixed ratio by mechanically operating a valve, damper, rheostat or various types of variable speed transmissions.

SENSITIVITY
Republic-Smoot regulators can be made sensitive to changes of less than 0.001 inch of water.

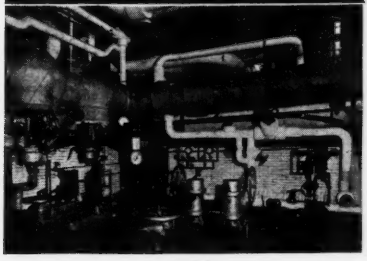
SPEED
Republic-Smoot regulators can be made to meet any speed requirement up to one full stroke in 2.4 seconds.

STABILITY
The patented Republic-Smoot stabilizer will stabilize against any time lag in the operation of the equipment being controlled.

POWER
Standard Republic-Smoot power cylinders will deliver from 360 to 5600 foot pounds per stroke.

WRITE FOR DATA BOOK No. S-13

DESUPERHEATERS



Designed to Meet Your Special Requirements

Whatever your plant conditions, you can obtain the necessary operating flexibility and accurate regulation of steam temperature with the rugged, simply-controlled Republic-Smoot desuperheaters described below.

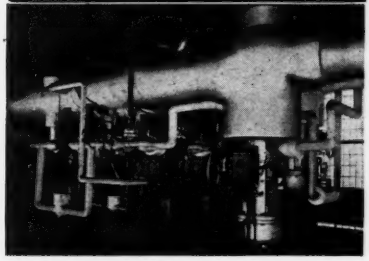
RATIO TYPE
This desuperheater is a self-supported venturi in which the desuperheating water, completely evaporated at all flows, is controlled by the steam flow in the correct proportion to reduce the steam temperature to the required value.

RATIO TANK TYPE
This unit is similar to the ratio type except that a water tank is added to give emergency water reserve.

STEAM ATOMIZING TYPE
In this desuperheater, built for extremely wide range operation and zero pressure loss, the desuperheating water is completely atomized at all rates of flow by a small quantity of high-pressure steam.

WRITE FOR BULLETIN No. S-30

—VALVES—



Regulating and Pressure Reducing

For your key jobs, where valves must not fail—where they must continuously and accurately regulate the pressures and flows of steam and water on which other vital processes depend—Republic-Smoot valves give you the dependability you need.

ANY STEAM CONDITIONS
These valves are of the gradual-opening, high-lift, double-seated type, lever or hydraulic-operated, built to A. S. A. standards for steam conditions up to 1500 lb. per sq. in., 950 F and capacities up to 1,000,000 lb. of steam an hour.

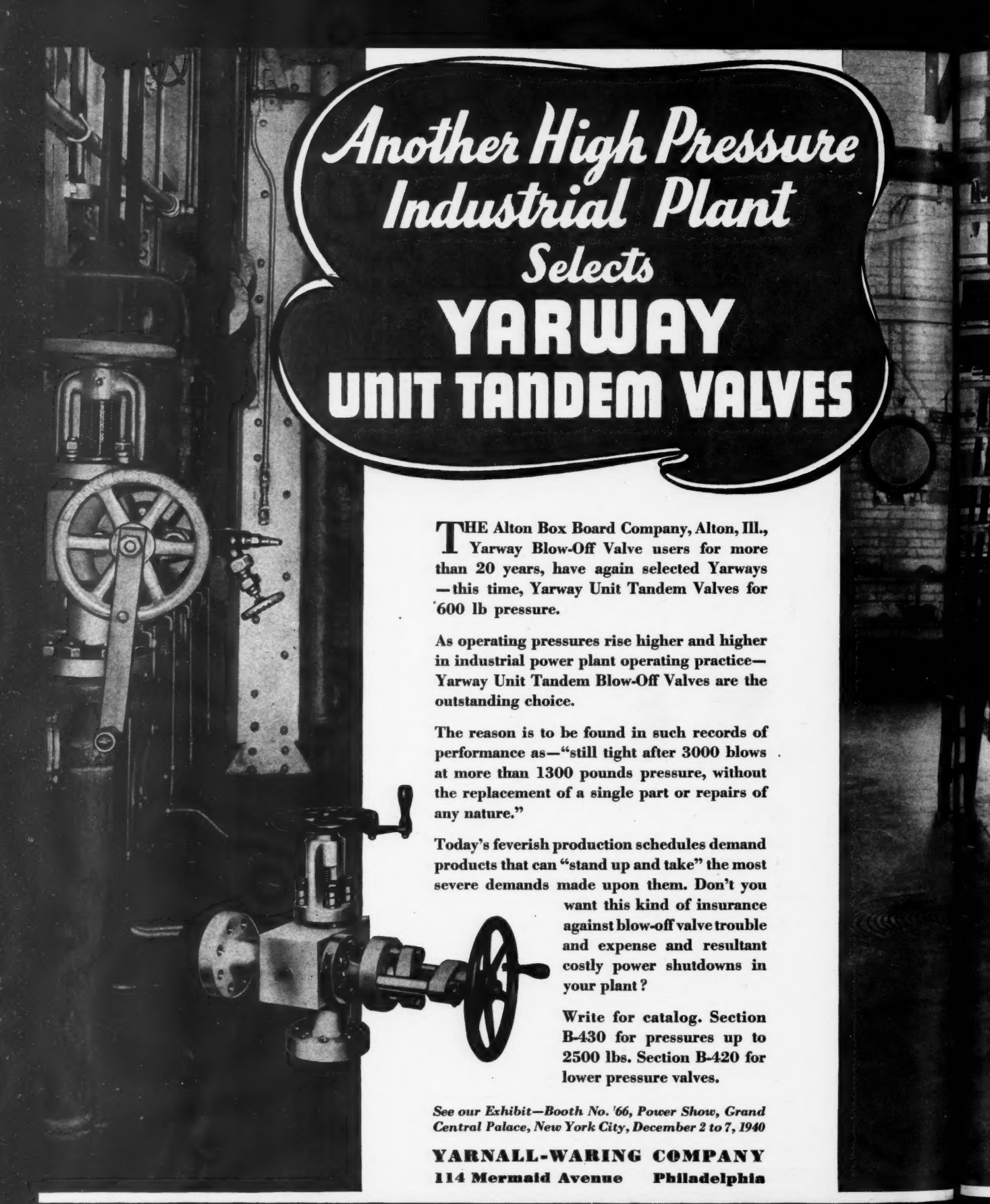
STABLE REGULATION
Republic-Smoot valves will regulate accurately from maximum flow down to 2 per cent of maximum.

CUSTOM MADE CONSTRUCTION
Republic-Smoot valves are built for any piping condition, with inlet and outlet sizes proportioned for specific pressure reductions. Special steels are used, depending on service requirements.

ONE-PIECE STEM
Valve stem and discs are machined from a single stainless steel forging.

WRITE FOR BULLETIN No. S-40

2224 DIVERSEY PKWY., CHICAGO, ILL.



Another High Pressure Industrial Plant Selects YARWAY UNIT TANDEM VALVES

THE Alton Box Board Company, Alton, Ill., Yarway Blow-Off Valve users for more than 20 years, have again selected Yarways —this time, Yarway Unit Tandem Valves for 600 lb pressure.

As operating pressures rise higher and higher in industrial power plant operating practice— Yarway Unit Tandem Blow-Off Valves are the outstanding choice.

The reason is to be found in such records of performance as—"still tight after 3000 blows at more than 1300 pounds pressure, without the replacement of a single part or repairs of any nature."

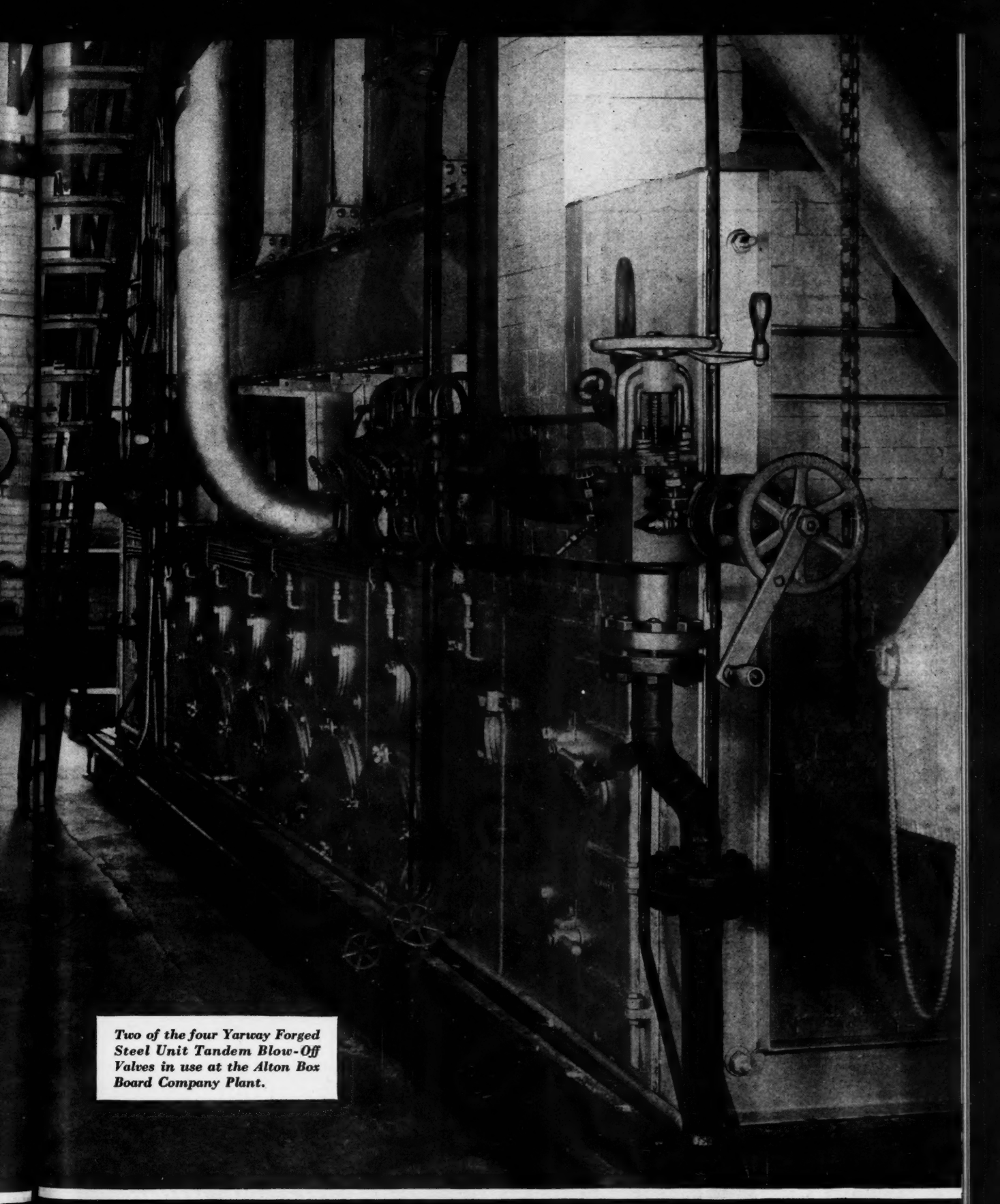
Today's feverish production schedules demand products that can "stand up and take" the most severe demands made upon them. Don't you want this kind of insurance against blow-off valve trouble and expense and resultant costly power shutdowns in your plant?

Write for catalog. Section B-430 for pressures up to 2500 lbs. Section B-420 for lower pressure valves.

See our Exhibit—Booth No. '66, Power Show, Grand Central Palace, New York City, December 2 to 7, 1940

YARNALL-WARING COMPANY
114 Mermaid Avenue Philadelphia

YARWAY



Two of the four Yarway Forged Steel Unit Tandem Blow-Off Valves in use at the Alton Box Board Company Plant.

BLOW-OFF VALVES

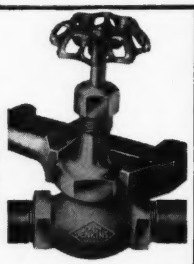
A Few Pennies More *Saves*

1 DISC HOLDERS READY LOADED

Keep a few extra disc holders on hand already loaded with the Jenkins Discs recommended for your services. Then you are ready to make replacements in the minimum time because disc holders are reloaded in spare time.

2 BONNET QUICKLY REMOVED

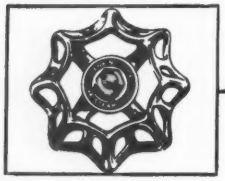
Apply a wrench to the husky one-piece bonnet and unscrew. By raising the spindle a turn or two you will prevent the disc holder from falling off the spindle.



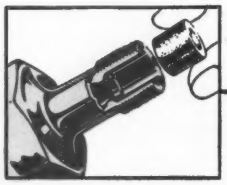
3 SLIP OFF OLD— SLIP ON NEW

Now turn the spindle all the way down and the disc holder will slip off in your hand. Slip on the holder containing the new disc—return the trimming to the body, for "good as new" service.

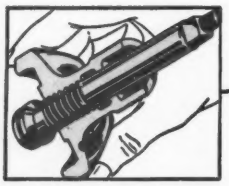
A MINUTE . . . OR TWO AND . . . YOU'RE THROUGH



PERFECT GRIP HANDWHEEL of the non-heat type—designed to prevent contact of hand with a hot wheel nut.

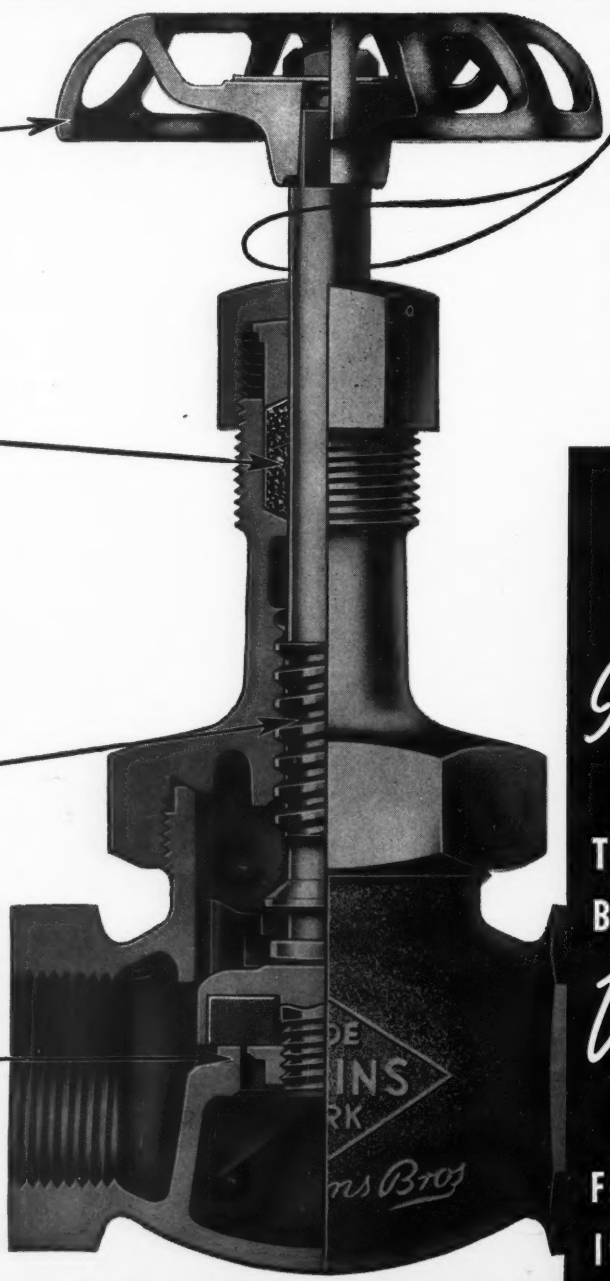


EXTRA DEEP STUFFING BOX contains an exceptional amount of packing—requires less frequent renewal, gives extra protection against leakage.



MORE SPINDLE THREADS mean extra threads in contact with the bonnet—assure extra service, less spindle wear.

HIGH, WIDE SEAT assures maximum seating surface against the disc and permits repeated refacing operations.



FOR 150-LBS. STEAM OR 300-LBS. O.W.G.

This valve is regularly fitted with Jenkins 119-A Disc, recommended primarily for saturated steam service up to 150 lbs. For recommended discs suitable for handling hot water, cold water, air and gas, gasoline, acids and alkalis, etc., consult the Jenkins Disc Guide.

CAN BE FITTED WITH THE PROPER DISC FOR ANY SERVICE

Interchangeable Parts—

THAT CUT YOUR COSTS BY PROVIDING

Valve Combinations

FOR 90% OF INDUSTRIAL PIPING

Dollars in Operating Costs

WHEN YOU ASSIGN VALVE JOBS TO

Jenkins 106-A

COMBINATIONS WITH JENKINS RENEWABLE DISCS

We built this Jenkins 106A "Family" for the Engineer who wants absolutely drop-tight service, with maximum ease of maintenance . . . and is willing to pay a little more for these money-saving advantages.

It is revolutionary in design—from the extra convenience features, to the complete interchangeability of parts as pictured below. Note how the bonnet is made in one sturdy piece—how it can be taken off and reassembled repeatedly without danger of distorting or springing the body.

Then there is the convenient slip-on, stay-on disc holder that takes but a few simple operations to replace a disc and get "good-as-new" valve performance.

Now see the unique way Jenkins 106A "Family" works together—so that you can adapt valves to any service without removing bodies from the line. This interchangeability, which no other valve manufacturer offers you means faster, easier maintenance with a minimum number of stock parts.

These valves are obtainable from your supply house. For further details ask for descriptive Bulletin No. 189.

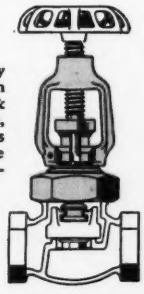
JENKINS BROS., 80 White Street, New York, N.Y.; Bridgeport, Conn.; Atlanta, Ga.; Boston, Mass.; Philadelphia, Pa ; Chicago, Ill.; Houston, Texas. Jenkins Bros., Ltd., Montreal; London, England

GLOBE OR ANGLE BODY Screwed or Flanged

Start with standard 106-A trimming. This is exactly the same for Globe or Angle body, screwed or flanged.

with OUTSIDE SCREW AND YOKE

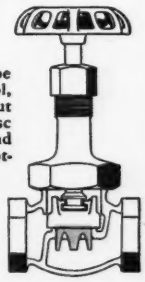
Similarly all four body styles can be fitted with the one standard O.S.& Y. trim. In other words, if service conditions necessitate it, the valve can be quickly converted merely by changing the trim.



for THROTTLING SERVICE

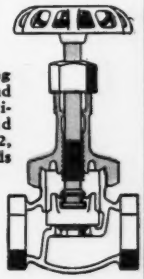
If the valve is to be used for close control, simply remove the nut which holds the disc in the disc holder and replace with this throttling nut Fig. 344.

For use on Fig. 106-A to 109-A inclusive. Also 106-AY to 109-AY.



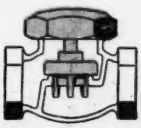
for QUICK OPENING

For services requiring quicker opening and closing, simply substitute this bonnet and spindle from Fig. 942, in which the threads are pitched more sharply.



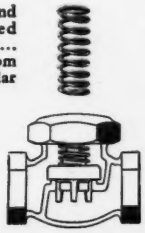
for LIFT CHECKS

Globe and Angle bodies can be fitted with this one set of trimming for lift check service. Trim consists of Cap, Disc Holder and Disc Holder Nut from Fig. 117-A.



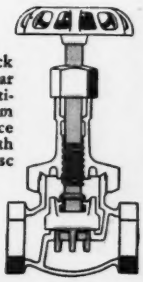
for SPRING LOADED CHECKS

For air compressor and other Spring-loaded check valve services... simply add Spring from Fig. 655-A to regular lift check valve.

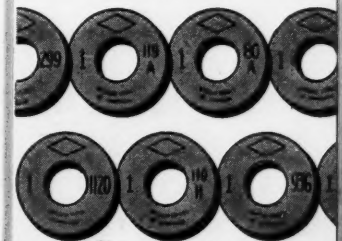


for STOP AND CHECK

For Stop and Check service, use the regular 106-A trim but substitute this Spindle from Fig. 630-A and replace regular disc nut with the check valve disc nut.



DISCS MADE BY JENKINS



For all these valves, pick the disc *exactly* compounded for the pressure, temperature and fluid to be handled —hot water, cold water, steam, oil, gasoline, air, gas, and other services.

Rx for Superior Packing Performance against Steam

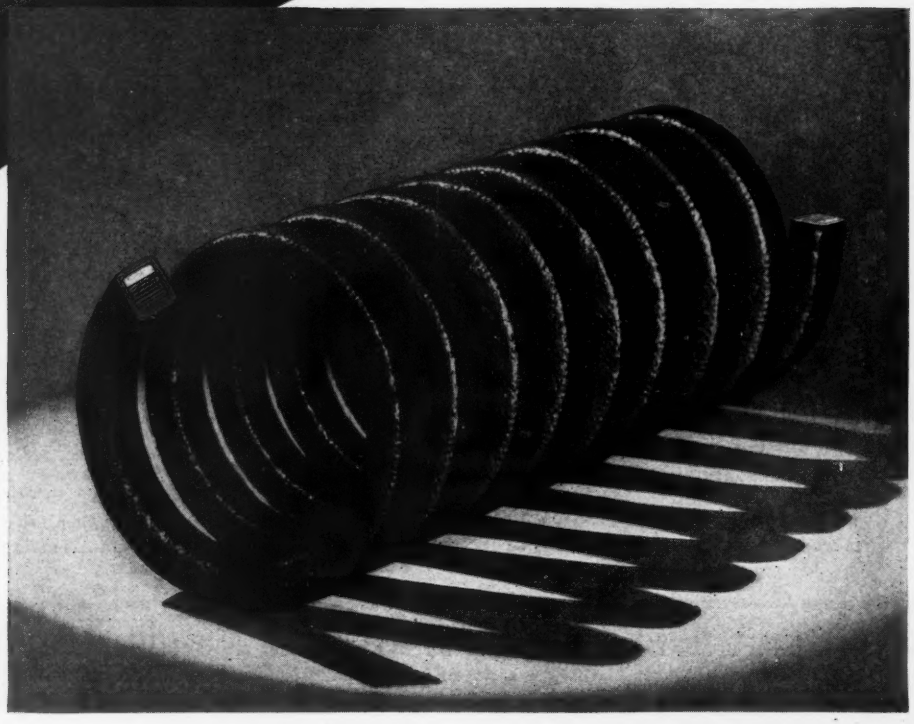


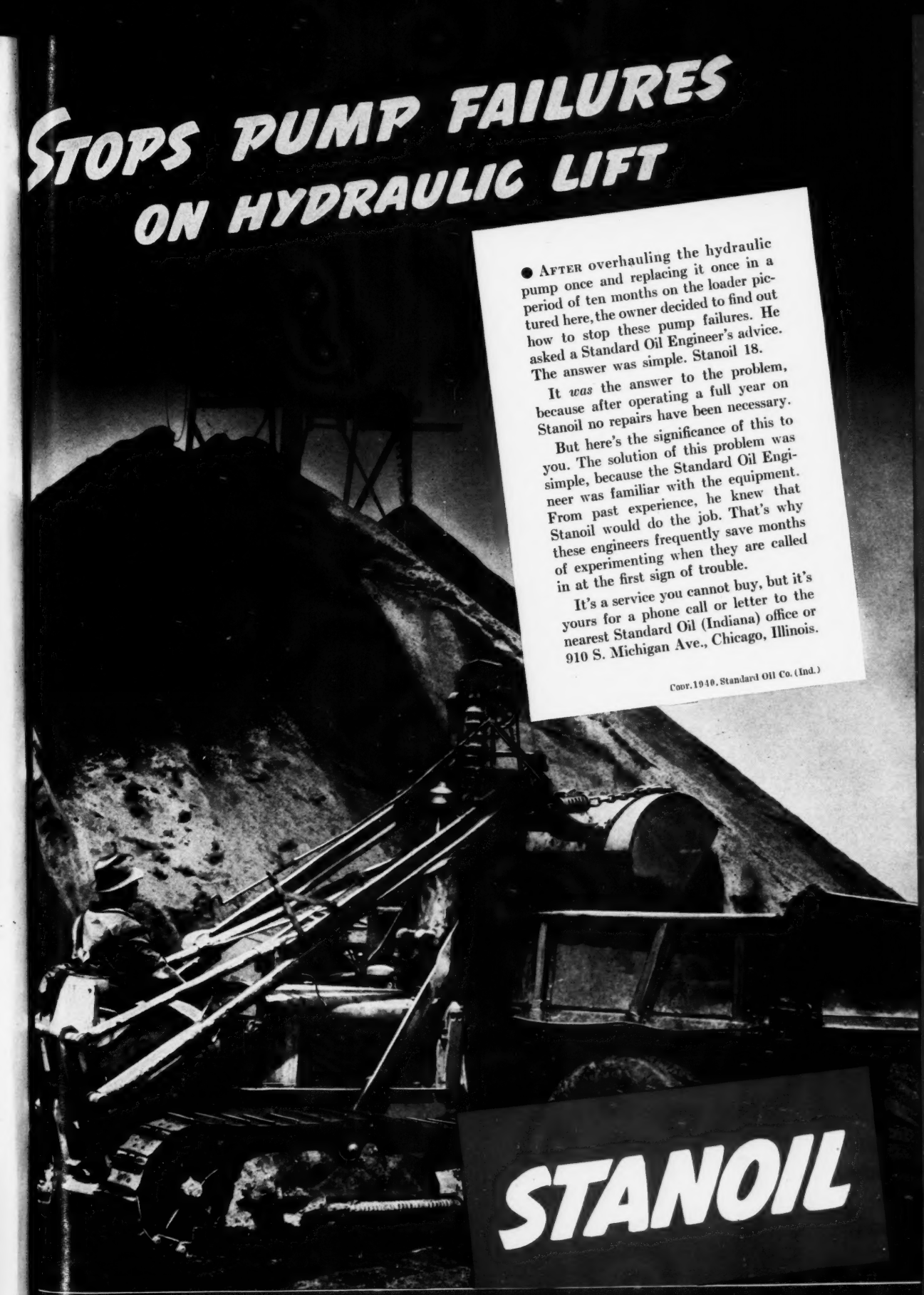
Illustration shows GARLOCK 150 spiral. If coil form is desired—specify GARLOCK 125. If cut rings are desired—specify GARLOCK 200.

WHY do so many thousands of engineers "prescribe" GARLOCK 150 High Pressure Packing—consistently year after year? Because they know from experience that GARLOCK 150 is *tough, strong, dependable.* They know it prevents costly shut-downs for frequent repacking. They know it saves money. For superior performance on piston rods of engines, pumps, compressors, expansion joints, etc., against steam pressures up to 300 lbs., standardize on GARLOCK 150.

THE GARLOCK PACKING CO., PALMYRA, N. Y.
In Canada: The Garlock Packing Co. of Canada Ltd., Montreal, Que.

GARLOCK 150

STOPS PUMP FAILURES ON HYDRAULIC LIFT



● AFTER overhauling the hydraulic pump once and replacing it once in a period of ten months on the loader pictured here, the owner decided to find out how to stop these pump failures. He asked a Standard Oil Engineer's advice. The answer was simple. Stanoil 18.

It *was* the answer to the problem, because after operating a full year on Stanoil no repairs have been necessary.

But here's the significance of this to you. The solution of this problem was simple, because the Standard Oil Engineer was familiar with the equipment. From past experience, he knew that Stanoil would do the job. That's why these engineers frequently save months of experimenting when they are called in at the first sign of trouble.

It's a service you cannot buy, but it's yours for a phone call or letter to the nearest Standard Oil (Indiana) office or 910 S. Michigan Ave., Chicago, Illinois.

Copr. 1940, Standard Oil Co. (Ind.)

STANOIL

STANDARD OIL COMPANY (INDIANA)

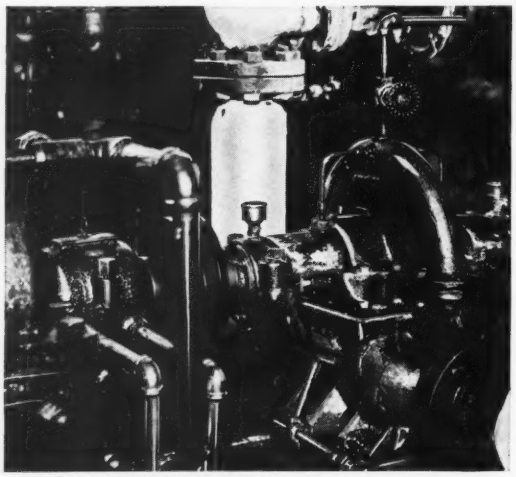
...LUBRICATION ENGINEERING...LUBRICATION ENGINEERING...LUBRICATION ENGINEERING...LUBRICATIO

...LUBRICATION ENGINEERING...LUBRICATION ENGINEERING...LUBRICATION ENGINEERING...LUBRICA

SUPERLA GREASE STOPS BEARING FAILURES IN BOILER FEED PUMP

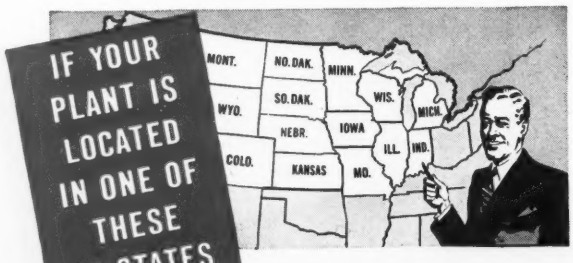
The turbine-driven boiler feed pump pictured below in a Central State institution had a large appetite for grease. A number of greases were tried, but all leaked out of the bearings rapidly and while these tests were being made bearings burned out in two instances.

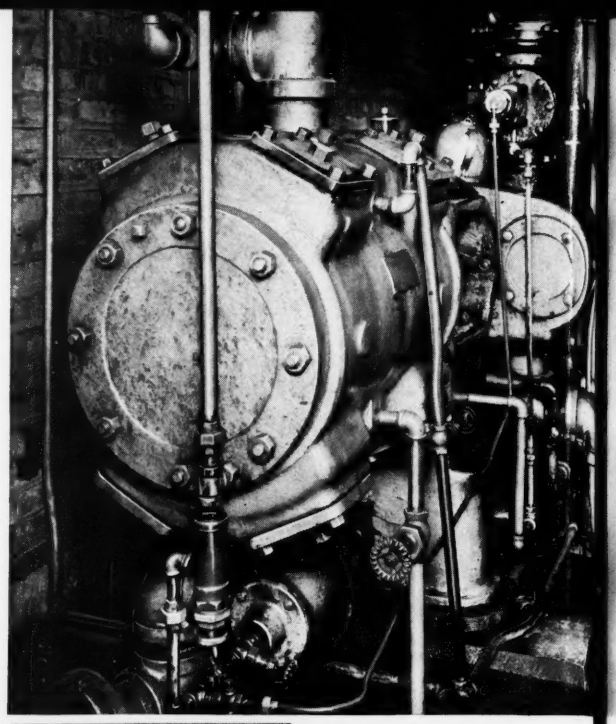
After that a Standard Lubrication Engineer was called. He analyzed operating conditions: turbine speed 3450 RPM; steam pressure 210 lbs. per sq. in.; feed water temperature 215° F. He also checked the bearings for alignment and clearance. Then he recommended Superla 2X Grease. And that ended all experimenting and bearing trouble.



STANOIL SOLVES GEAR CASE TEMPERATURE PROBLEM

Small reduction gears on a motor driven adding machine were responsible for an undue number of service calls. It wasn't serious, but after long periods of continuous operation the gear case would become overheated. The manufacturer decided it was a problem for his Standard Lubrication Engineer. And rightly so, for after examining the gears the Engineer recommended a test of Stanoil 51. First it was tried in factory tests—temperatures remained normal. Then it was put in a few of the cases that had caused the service calls. Again Stanoil eliminated all overheating complaints.





STANOIL CURES UNLOADER STICKING IN COMPRESSOR

The unloader on a compressor in a Michigan refrigeration plant had to be cleaned so often that the engineer decided it would become worn out just from taking it down and cleaning it. Without this frequent cleaning it would operate only a short time without stieking, even though a special air compressor oil was being used.

Without wasting any time experimenting with other compressor oils, the engineer called in a Standard Lubrication Engineer. He knew what was needed. First, the oil should have the right viscosity and maintain it under widely varying temperature conditions. Secondly, it must be free from carbon or gum forming tendencies even after long periods of operation. That oil, the Engineer knew, was Stanoil.

Stanoil was installed. Since then, the unloader on this compressor is now cleaned once every six months and sticking is unknown.

A FAST WAY TO SOLVE YOUR LUBRICATING PROBLEMS

Because you haven't time today to spend weeks or months trying various lubricants on some troublesome lubricating job, don't neglect it. Let a Standard Lubrication Engineer help you. His first recommendation will most likely clear up the problem. Call your local Standard Oil (Indiana) office or write 910 South Michigan Avenue, Chicago, Illinois. In Nebraska write Standard Oil of Nebraska at Omaha.

Billings, Montana
Chicago, Illinois
Davenport, Iowa
Decatur, Illinois
Denver, Colorado
Des Moines, Iowa
Detroit, Michigan
Duluth, Minnesota
Evansville, Indiana
Fargo, North Dakota
Grand Rapids, Michigan
Green Bay, Wisconsin
Huron, South Dakota
Indianapolis, Indiana
Joliet, Illinois
Kansas City, Missouri
LaCrosse, Wisconsin
Mankato, Minnesota
Mason City, Iowa
Milwaukee, Wisconsin
Minneapolis, Minn.
Peoria, Illinois
Quincy, Illinois
Saginaw, Michigan
St. Joseph, Missouri
St. Louis, Missouri
South Bend, Indiana
Wichita, Kansas

YOU CAN GET STANDARD OIL ENGINEERING SERVICE

● *This display in booths 54 and 55 at the New York Power Show will include diagrammatic drawings showing the application of Bailey Meter Control to recent boiler installations, as well as an operating exhibit of Bailey Meter Control.*

COMPLETE COMBUSTION CONTROL

Continuously Maintains Optimum Combustion Conditions

● To continuously receive full value from steam generating units, they should be equipped with complete combustion control incorporating a Steam Flow—Air Flow Boiler Meter to automatically maintain optimum combustion conditions in each boiler furnace.

This system not only maintains steam pressure, furnace draft, and load distribution among boilers, but it also automatically readjusts the fuel or air to maintain maximum combustion economy.

For a maximum return include Bailey Meter Control, the complete combustion control system in your power modernization plan. It is one of the few high-return investments open to you today.

Ask for Bulletin No. 102-B

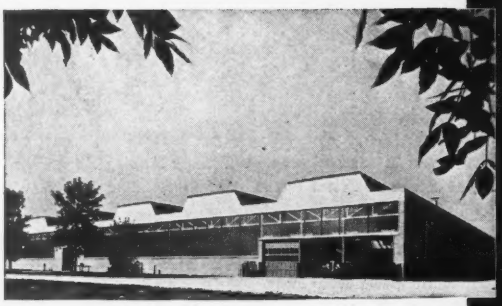
BAILEY METER COMPANY
1040 IVANHOE ROAD • CLEVELAND, OHIO
Bailey Meter Company Limited, Montreal, Canada A-47

BAILEY METER CONTROL

The Complete Combustion Control System

BOILER METERS • MULTI-POINTER GAGES • FLUID METERS • RECORDERS • SUPERHEAT CONTROL • DESUPERHEAT CONTROL • COMBUSTION CONTROL • FEED WATER CONTROL

COAL
THE MODERN FUEL
FURNISHES ECONOMICAL HEAT & POWER FOR NASH MOTORS' NEW $7,000,000 PRODUCTION SET-UP



This new section of Nash's Kenosha, Wisconsin, plant represents a part of the $7,000,000 expenditure for production revamp.

Here's a big, modern manufacturing plant on paper! This photograph shows Nash plant engineers checking the layout of 14 miles of production and conveyor lines, prepared to make the "Nash Ambassador 600"—newest contender in the low-price car field.

● In the great majority of plants, where complex equipment is geared to tight production schedules, you find the modern, *dependable* fuel—COAL. Nash is in line with the leaders, relying on coal to give them unfailing power and heat at minimum maintenance and steam costs.

Coal is a "flexible" fuel . . . able to do an *economical* job for plants of every size. Perhaps, as in so many cases, Chesapeake and Ohio's Fuel Service Engineers can show *you* the way to greater operating reliability at lower fuel cost. The services of these trained engineers are free of charge. And if you have a job for a specific kind of coal, we can help still further. This railroad serves "The Coal Bin of America," where the mechanized mines of these great bituminous fields can uniformly prepare coal to exact specifications, as to B. T. U., ash softening temperature, high or low volatility, grindability.

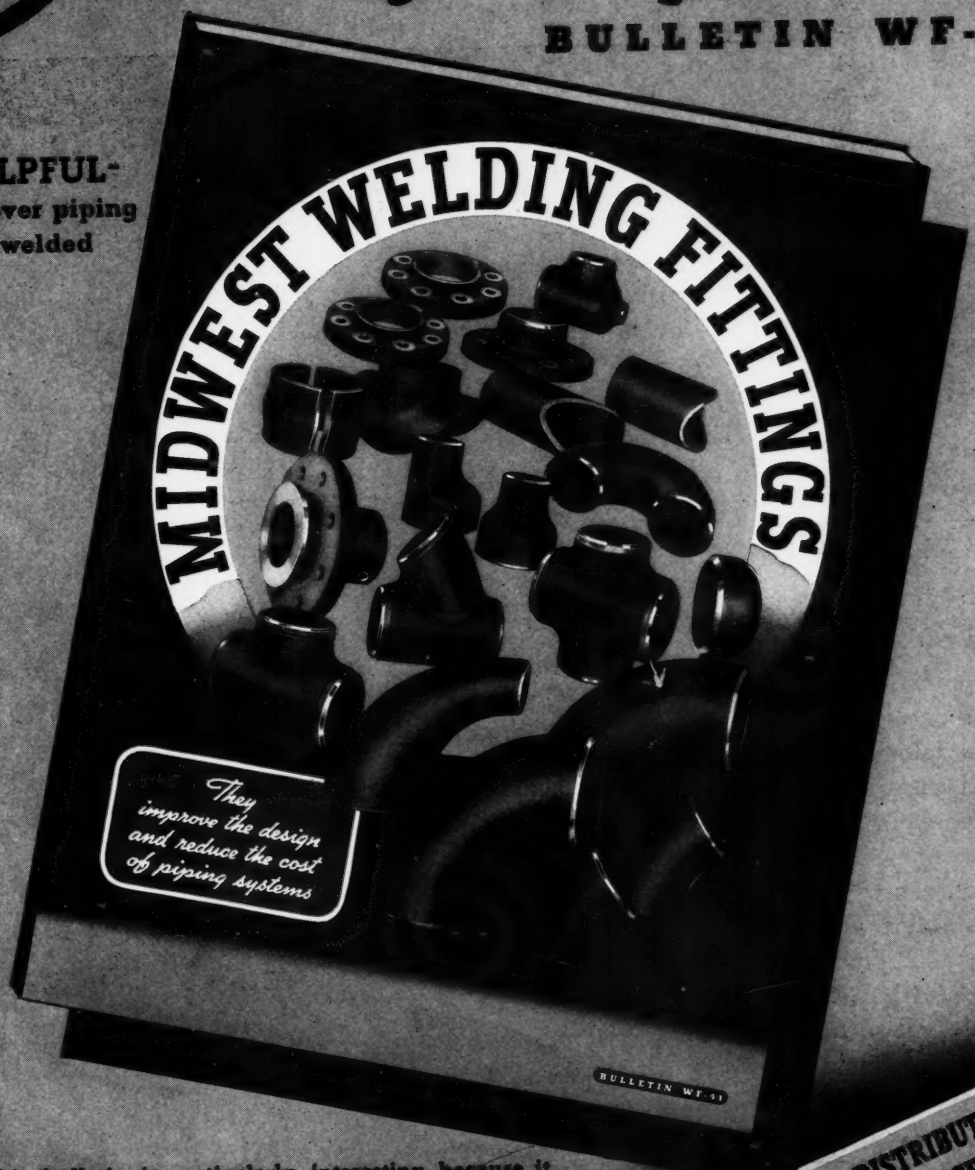
For information or assistance with your fuel problems, write GEORGE H. REINBRECHT, Coal Traffic Manager, Chesapeake and Ohio Lines, 2903 Terminal Tower, Cleveland, O.

CHESAPEAKE AND OHIO LINES

Just off the press-

BULLETIN WF-41

HELPFUL-
wherever piping is welded



This bulletin is particularly interesting because it describes new welding fittings not previously available. It also gives the new American Standard for butt-welding fittings. Write for a copy today.

Ask NEAREST DISTRIBUTOR OR MIDWEST OFFICE FOR YOUR COPY Now

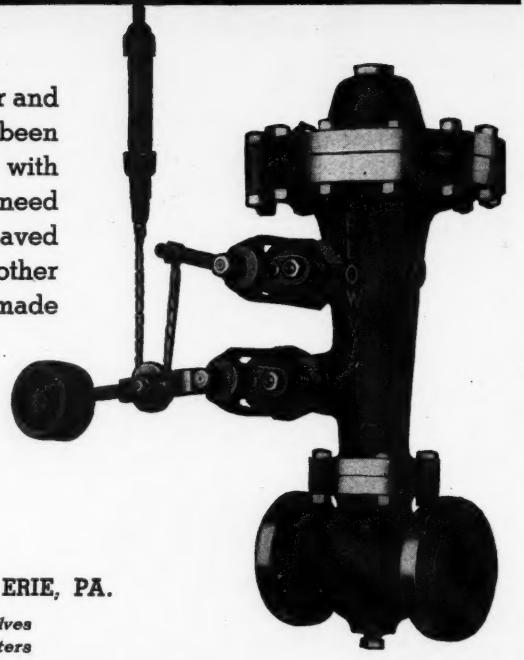
MIDWEST PIPING & SUPPLY COMPANY, INC.
Main Office: 1460 S. Second St., St. Louis, Mo.

Plants: St. Louis, Passaic (N.J.) and Los Angeles • Sales Offices: Chicago—949 Mar... ...ston—229 Shell Building
Los Angeles—520 Anderson St. • New York—(Eastern Division) 30 Church St. • San Francisco—... ...Bldg. • Tulsa—833 Mayo Bldg.

14 COPES Flowmatics ordered by paper mill . . . to save $13,000 a year . . . to make boiler operation SAFER

To hold a safer water level on its seven power and seven recovery boilers, this paper mill has been supplementing its semi-automatic regulators with hand feed. Since the COPES Flowmatic would need no supplementary feeding, $13,000 could be saved each year by releasing water tenders for other duties—while the closer water level control made boiler operation safer.

You can profit from the closer, safer boiler water level control provided by the fully-automatic, trouble free COPES Flowmatic. Write for Bulletin 429, which describes this simplified two-element COPES Regulator.



NORTHERN EQUIPMENT CO., 1202 GROVE DRIVE, ERIE, PA.

Feed Water Regulators, Pump Governors, Differential Valves
Liquid Level Controls, Reducing Valves and Desuperheaters

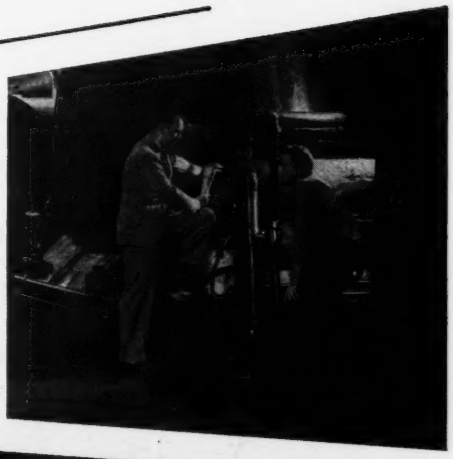
COPES — FEEDS BOILER ACCORDING TO STEAM FLOW-AUTOMATICALLY

★ GET CLOSER LEVEL CONTROL WITH THE FLOWMATIC ★ REGULATOR

"GULFCREST OIL

is the MOST STABLE TURBINE OIL we've ever used"...

says *Power Plant Engineer*



GULF PERIODIC CONSULTATION SERVICE plays on important part in the operation of this large modern Power Plant.

"It stays in better condition and lasts longer than ordinary Turbine Oil."

"GULFCREST Oil shows far less deterioration than any turbine oil we've ever used," says this Power Plant Engineer. "The remarkable stability of this turbine oil gives us complete assurance of high efficiency of our turbine lubrication."

The performance records of Gulfcrest Oil in turbine systems of many of the leading power plants in the country are unparalleled. Read the four reasons (at the right) *why* Gulfcrest is the finest turbine oil you can buy!

Call in a Gulf engineer and ask him to give you the complete story of Gulfcrest—ask him to explain how GULF PERIODIC CONSULTATION SERVICE will help you maintain greater lubrication efficiency. Write or phone your nearest Gulf office today.

4 Reasons....

1. *Refined by the* ALCHLOR *Process.* The most thorough and effective method for removing chemically active hydrocarbons as well as the general run of impurities present in all crudes.

2. *Highest resistance to oxidation.* This famous ALCHLOR Process synthesizes and rearranges the molecular structure of certain hydrocarbons, resulting in a finished product of greater stability. GULFCREST OIL stands alone in its high resistance to oxidation.

3. *Highest resistance to acidity and sludge.* Because of the elimination of oxidation catalysts in addition to the unparalleled refining power of the Alchlor Process, these oils form less gum deposits, less emulsion and sludge, when mixed with water over a period of several years continuous operation, than any other turbine oil of which we have record.

4. *Highest kilowatt-hour performance.* Because Alchlor not only makes possible an oil more thoroughly refined and homogeneous but also creates anti-oxidants, these oils have great resistance to deteriorating influences and are longer lived. Less make-up oil is required.

This booklet will suggest to you a practical method by which you can reduce operating and maintenance costs for your equipment. Write for your free copy.

GULF INDUSTRIAL LUBRICATION

Gulf Oil Corporation · Gulf Refining Company
3813 Gulf Building, Pittsburgh, Pa. P.P.E.

Please send me my copy — no charge — of the booklet "GULF PERIODIC CONSULTATION SERVICE."

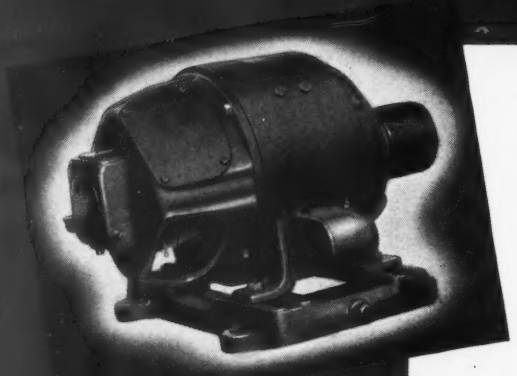
Name .....

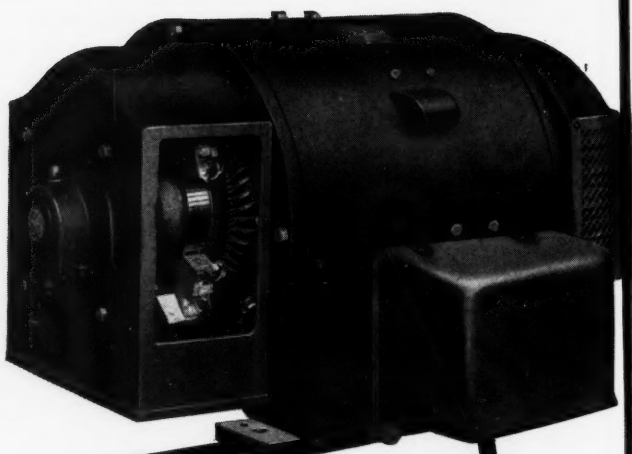
Company .....

Address .....

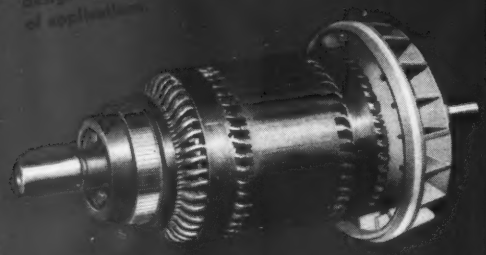
There's DOUBLE

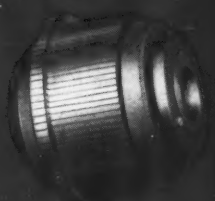
in the NEW





G-E direct-current motor, Type CD, typical of the larger ratings.

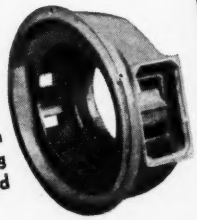




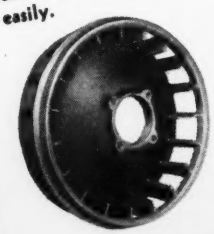
An improved ventilating system, designed for reversible rotation, gives positive axial ventilation through the motor.

The same bearing bracket is used for ball and sleeve bearings, and the bearings can be removed without disturbing brush-rigging connections.

The larger motors have a new "V-type" brush holder designed for reversing service.



Split construction of the highly efficient fan scroll, which forms the drive-end bearing bracket, allows the scroll to be removed easily.



The radial-blade fan is cast-aluminum and specially designed for use in reversing service. The fan is rabbetted and bolted to the armature spider.

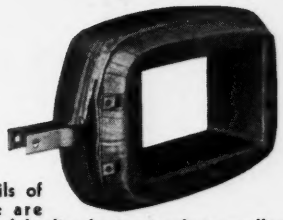
PROTECTION

Exposed Parts Protected against External Damage

The over-all design of the open motor makes it readily adaptable for use even on jobs that have natural hazards to motor life. It not only safeguards the motor parts, but also increases safety for workmen.

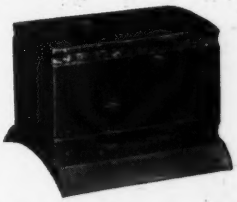
Protected Internally against Electrical Failure

Electrical protection is gained through the use of Formex magnet wire in the armatures and field coils, and by a final treatment of a specially developed Glyptal base insulating varnish which gives additional value to the other fine insulating materials used.



Main field coils of Formex wire are wound on spool bodies having insulating collars that insulate coil and pole from frame. Each coil is taped, dipped, and baked. A completed coil is shown above.

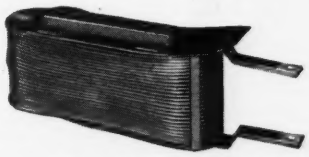
OTHER new features of G-E d-c motors include such improvements as cast-aluminum fans specially designed for reversing service; reversal without changing any part of the frame, fan, or brush rigging; compact assembly; more positive ventilation; lower WR^2; small diameter, which means low headroom needed; and interchangeability of ball- and sleeve-bearing brackets on the larger motors.



Main field pole pieces are laminated silicon steel, welded together and securely bolted to rolled-steel frame.

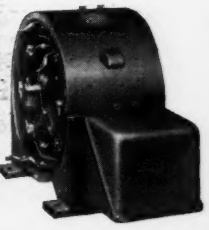
These and additional features which all sum up to increased all-round performance and protection are rolled-steel frames, V-type brush holders, cast-brass brush-holder boxes, accurately centered rabbet fit of precision machining, extra large conduit box, provision for lubricating and flushing of bearing while motor is running, punched commutator segments, Textolite wedges in armature slots for winding protection, and constant air gap.

All current-carrying parts and rotating parts, except shaft extensions, can be enclosed readily for protection of operators.

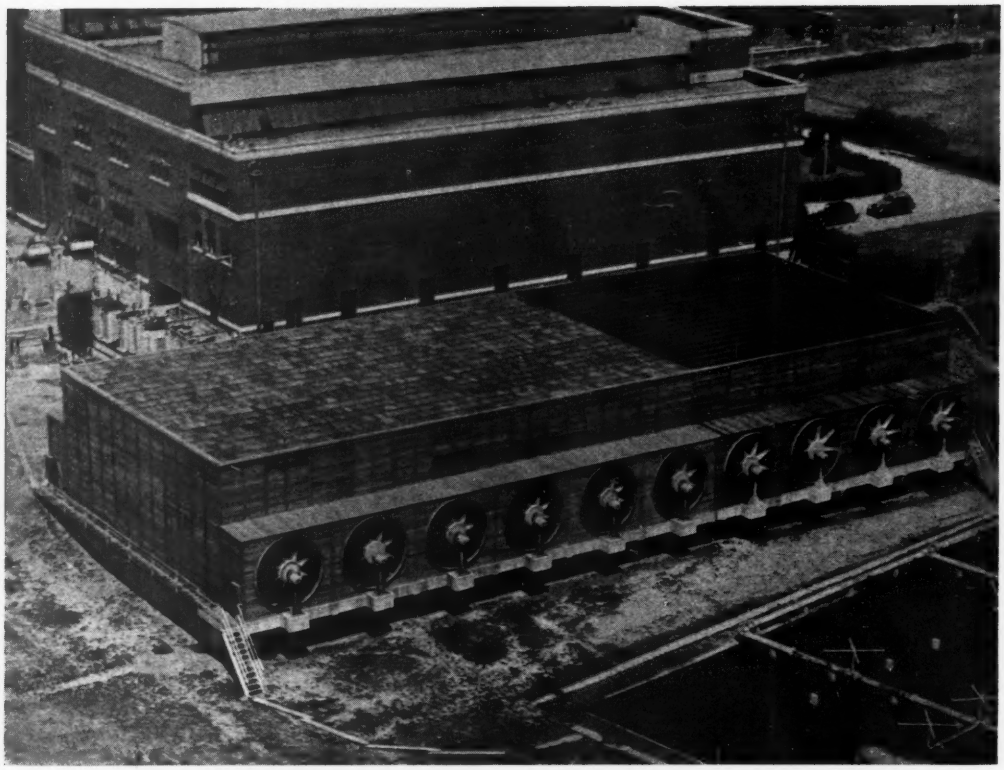


Commutating coils are made of edgewise-wound copper strip with enamel turn insulation, and are insulated from the pole by a layer of laminated acetate paper.

Surely you will want to learn more about motors with such outstanding improvements. These G-E direct-current motors are being applied in increasing numbers on jobs for which standard designs formerly were not recommended. They are fully fitted to fill the bill on your jobs. Call our local office. General Electric Company, Schenectady, N.Y.



Continuous rabbet fit of rolled-steel frame assures accurate concentricity and alignment of the bearing bracket. Additional insulation protects the basic dielectric strength of Formex wire, and red Glyptal varnish protects the coils.



20 cell, Low Head cooling tower, cooling 43,100 gallons of condensing water per minute for 15,000-kw. and 10,000-kw. turbo-generators.

Positive, Low Cost Cooling

MECHANICAL DRAFT COOLING TOWERS

Physical and economic laws are compelling the conservation of water supply—greatly increasing demands of power generation, of industry, and of our growing population forbid the waste of valuable fresh water that has only served as a cooling medium.

In other cases the original water supply for condensers and processing is not sufficient to handle higher loads—and these frequently occur in the hot, dry summer season. Mechanical draft cooling towers are the most effective and economic solution of the difficulty for the following reasons:

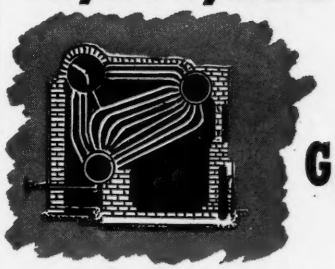
1. Water is pumped only twenty feet into the gravity distributing system, as against forty to fifty feet for comparable atmospheric towers. 2. Air is moved uniformly through the towers by Axial Flow fans. 3. Two decks of eliminators make spray loss negligible. 4. Performance is independent of wind velocity, insuring full capacity even during periods of dead calm.

FOSTER WHEELER CORPORATION, 165 Broadway, New York, N. Y.

FOSTER WHEELER

6 VERY IMPRESSIVE FACTS

12,614,000 lb. per hr.

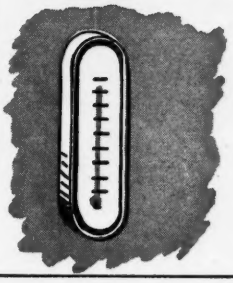


Steam Generated

690,000

K.W. per hr.
(High Pressure Units Only)
Capacity

900°F. to 950°F.

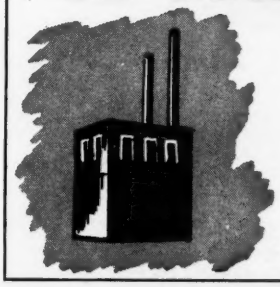


Temperature Conditions

1240 to 2200 lb.

Pressure Range

13 CONTRACTS



Awarded

4 YEARS

1936 to 1940

The Figures given above show the confidence placed by consulting engineers, central station and industrial plant engineers and operators in this organization's ability to design, prefabricate and erect piping, regardless of the size of the job. The Kellogg Company has also prefabricated and erected many piping jobs ranging from 200 pounds pressure up.

Call in this organization the next time you have a piping project.

THE M. W. KELLOGG COMPANY · JERSEY CITY, NEW JERSEY · 225 BROADWAY, N. Y.

REPRESENTATIVES

LOS ANGELES: 609 SOUTH GRAND — TULSA: PHILTOWER BLDG.

KELLOGG

"Musterflex" Prefabricated Piping Systems · "Masterweld" pressure vessels for Power, Refinery and Chemical Industries. Heat Exchangers. Pyrolytic and Catalytic Cracking Units, Reforming, Dehydrogenation, Alkylation, Desulphurization. Thermal and Catalytic Polymerization Units · JUIK Processes for Lubricating Oil Plants. Plastic Refractories · Radial Brick Chimneys.

ANNOUNC

ALLIS-CHALMERS *Electrifugal*

ING!

Here Are Engineering Advancements That Mean More Gallons... At Less Cost to You!

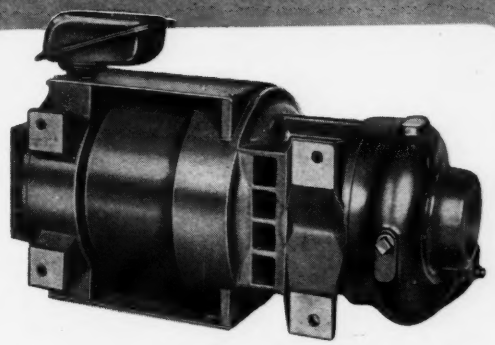
1. **All-in-One . . . Motor and Pump Designed as Unit on One Shaft and One Housing . . . Increases Compactness . . . Adds to Flexibility.**
2. **Allis-Chalmers Lo-Maintenance Motor . . . Developed Especially for This Work . . . Gives Maximum Pumping Efficiency at Lowest Power Cost . . . Built with Cast Iron Frame for Special Applications in Chemical Industry.**
3. **Splash-Proof Features . . . with Air Passages Baffled . . . Safeguard Motor from Liquids.**
4. **Fewer Parts to Wear . . . Better Fit to Parts Because of Fewer Machine Joints . . . Adds to Long-Life, Low-Cost Operation.**
5. **Indestructible Rotor . . . Distortionless Stator . . . Bronze Fitted Pump Parts . . . Large Space Provided for Adjusting Glands . . . and Other Features Assure You Improved Performance.**
6. **Greater Stability and Rigidity of All-In-One Design . . . Means Less Vibration . . . Lower Maintenance . . . Longer Life.**

THESE ARE ONLY a few of the great features that have been made a part of the new all-in-one Electrifugal Pump by Allis-Chalmers engineers . . . the same trail-blazing engineering that designed and built the gigantic Niagara Falls and Boulder Dam turbines . . . that originated the motor-coupled pump in 1926!

Here, in one unit, is the pump and motor combination you've been looking for . . . modern in appearance . . . ready to give you more gallons per dollar of power cost.

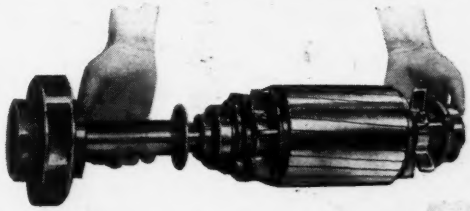
So before you buy . . . get the whole story of the new Allis-Chalmers Electrifugal Pump. Find out how well it fits into your present set-up . . . how it can save you money. Best of all — learn how you get these *extra-value features* at *no* extra cost.

Call the nearest Allis-Chalmers district office . . . or write Allis-Chalmers, Milwaukee . . . today! A-1300

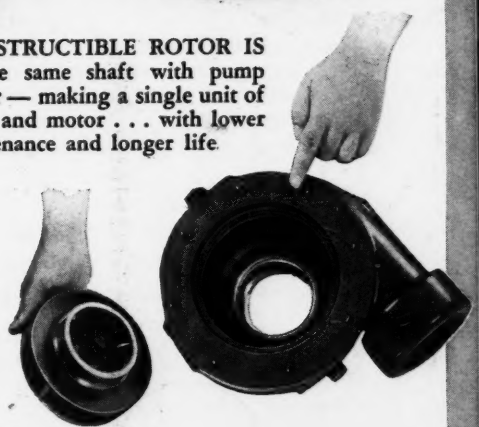


IN THIS UPSIDE-DOWN VIEW OF THE Electrifugal Pump, see how the air goes in and out through large air passages, keeping the motor cool at all times.

THIS DISTORTIONLESS, REMOVABLE Stator is one of the many outstanding features of the Allis-Chalmers Lo-Maintenance Motor used as integral part of the Electrifugal Pump.



INDESTRUCTIBLE ROTOR IS on the same shaft with pump runner — making a single unit of pump and motor . . . with lower maintenance and longer life.



THE ALLIS-CHALMERS ELECTRIFUGAL Pump has bronze runner wear rings, water seal ring, and shaft sleeve . . . has been designed to deliver maximum gallons at minimum cost.

PUMP *Cuts your Pumping Costs!*

TACKLE 'EM LOW!

THE football player who stops them cold is the one who stays close to the ground. And the same system gets results in other fields.

Take for example the lubricants that protect your machinery. Shell men have thrown friction for losses time and again by keeping close to the ground—*your* ground.

They have worked with Diesels and steam turbines, machine tools and textile looms, fishing vessels and steel mills . . . with equipment just like yours, throughout the years. The right lubricant for each job means lowered costs and longer life. And to be sure of the right lubricant, Shell men have found no substitute for first-hand study of machines-on-the-job.

• • •

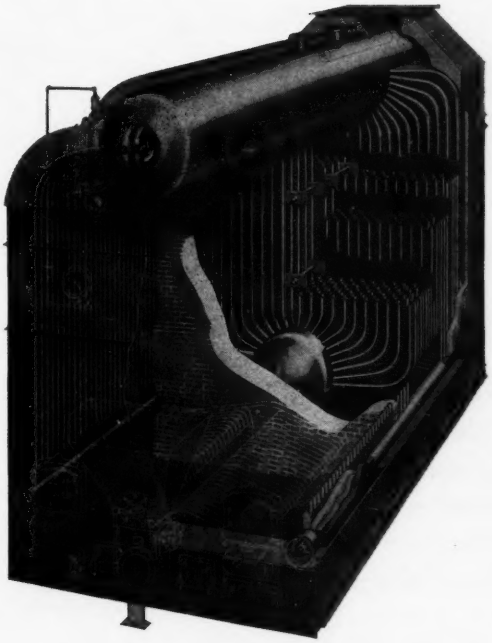
However, you're not nearly so interested in hearing case histories of the money they've saved other plants as in seeing how much money they can save in yours. ***The first step toward finding out is to call in your Shell man today.***

SHELL

SHELL INDUSTRIAL LUBRICANTS

Don't Take Our Word for it–

Read What Owners Have To Say



TYPE CP
STEAM GENERATOR

- "I didn't realize how antiquated my old boiler was until I installed a Keeler CP steam generator."
- "Our fuel cost for the two years, 1938 and 1939, was $10,180 less than for the two preceding years, 1936 and 1937. Since this boiler has already paid for itself we feel that our judgment in selecting this equipment has been thoroughly vindicated."
- "I would recommend these boilers to anyone in need of high pressure boilers. We have found them to be everything that the E. Keeler Co. claimed for them."
- "These boilers have lived up to our expectations on efficiency, capacity and quick pick-up. We do not believe we could have made a better purchase."
- "We have used one of the E. Keeler Co. type CP boilers for the past three or four years and we are more than pleased with same. In fact, I am confident we are saving 15 to 25 per cent over any other boiler we have used."
- "In comparison with a heavy duty boiler we formerly had on the same job, we are saving several hundred dollars monthly; in fact, we find that it will pay for itself in a period much shorter than the engineers figured."
- "We have had two of these generators in service at our plants for the past few years and during this time have experienced nothing but the best performance. They are well constructed and the maintenance on them has been practically nothing."

(Names will be given on request)

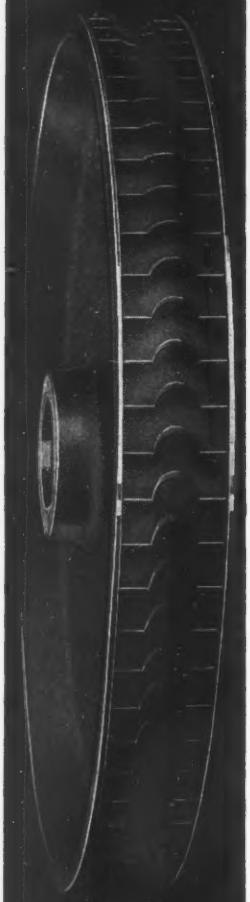
Bulletin F-9 Will Give You Complete Data — Write Us Today

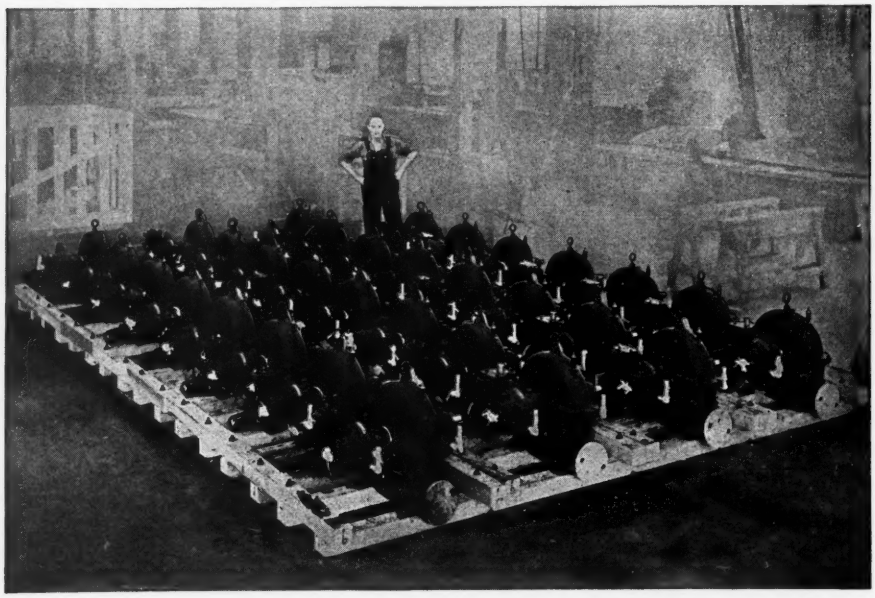
E. KEELER CO.

Builders of Better Boilers Since 1864

WILLIAMSPORT PENNSYLVANIA

TERRY





31 TERRY SOLID WHEEL TURBINES

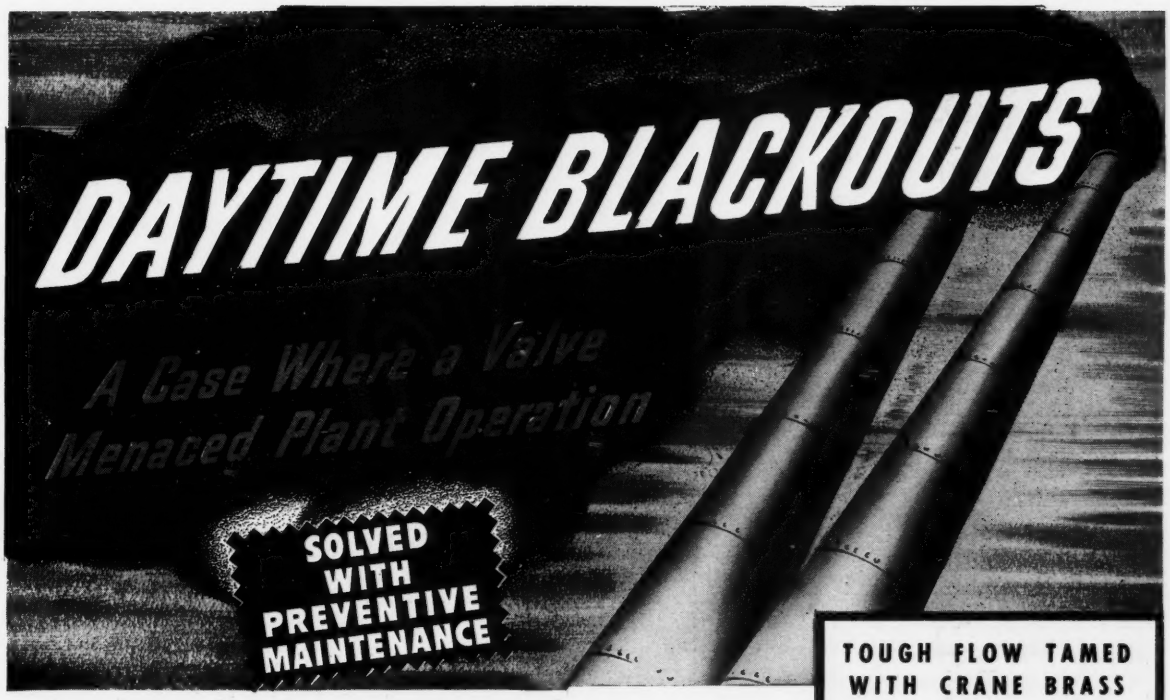
Recently ordered by a leading oil refiner

These units were selected on the basis of —
. . . Simple and durable construction.
. . . Solid one-piece blade design.
. . . Proven performance — For this Refiner has been a user of Terry Turbines for the past five years and knows their many other inherent qualities.

The Terry Solid Wheel Turbine is described in our Bulletin S-116. A request on your business letterhead will bring a copy.

T-1139

THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD, CONN.



FROM his window the Superintendent of a chemical processing plant saw the stacks belching smoke that turned day into night. It happened before—just recently.

He suspected boiler trouble. "Maybe, there's one reason for production delays!" He grabbed a phone. "Why the blackouts, Bill?"

"The forced draft blower is acting up," replied the engineer, "the valve in the steam line's gone out again!"

Only a short time ago this valve was repaired. Yet, again, it was causing irregular boiler operation and fuel waste; in fact, it might have crippled the boiler completely! That's how Preventive Maintenance—the modern way of protecting against trouble by stopping it at the source—came into the case.

The engineer knew that valves shouldn't behave that way. But he wouldn't risk ordinary repair again. And through the Crane Man, R. B. H., he would benefit from Crane's wide experience and knowledge in applying the best corrective measure.

The first step in applying Preventive Maintenance is making sure that valves and fittings are right for working conditions.

Here was a renewable disc valve in the steam line to a turbine-type blower. It couldn't stand the "gaff" of constant throttling. The disc wouldn't last. The draft blower ran wild!

Preventive Maintenance counseled replacement with a Crane No. 14½P—a plug type disc valve designed for tough throttling jobs. Its materials and construction would safely resist the ravaging effects of throttled steam. It would give unvarying control of flow—keep the blower running at constant speed.

RESULTS: No more blackouts even after two years. The menace of interrupted boiler operation, fuel waste, even complete shutdown was eliminated with Preventive Maintenance. Another user of piping knows that the Crane Man can help get most for piping maintenance dollars. Because, Crane is not only the source of valves and fittings for every need, but also of accurate information on their proper usage.

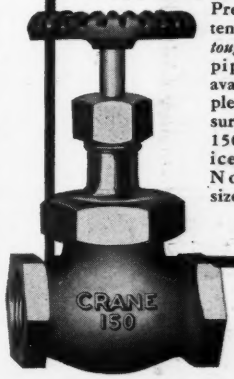
This case is based on the personal experience of R. B. H., a Crane Representative in our Minneapolis Branch.

TOUGH FLOW TAMED WITH CRANE BRASS PLUG DISC VALVES

In your boiler room—in any lines requiring severe throttling, you'll find these valves exactly right for the job. They're sound protection against trouble in blower, blow-off and boiler-feed services, in drip and drain lines.

The unusual stamina of these Crane valves is in their plug-type disc and seat construction. Materials are just the right combination for highest resistance to the corrosion and erosion of actual working conditions. The wide seating area repels the damaging effects of wire-drawing and foreign matter; assures long-lasting tightness. The tapered disc provides easy, positive regulation of flow.

With Crane Plug Disc valves, you can apply money-and-trouble-saving Preventive Maintenance to all the *tough* spots in your piping. They're available in a complete range of pressure ratings. For 150 pound services, specify the No. 14½P—in sizes up to 3 inches.

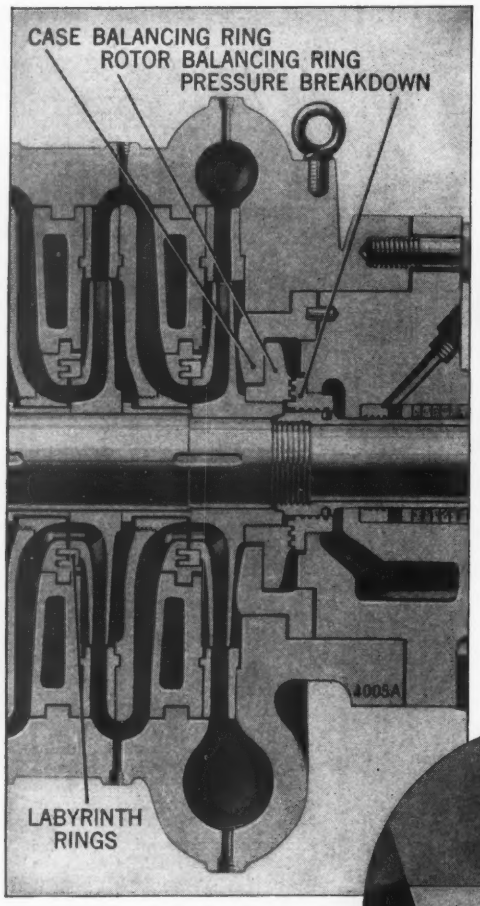


CRANE

CRANE CO., GENERAL OFFICES:
836 S. MICHIGAN AVE., CHICAGO

VALVES • FITTINGS • PIPE
PLUMBING • HEATING • PUMPS

Inspect Crane Products at the Power Show—Booth 53—Grand Central Palace, New York—Dec. 2 to 7



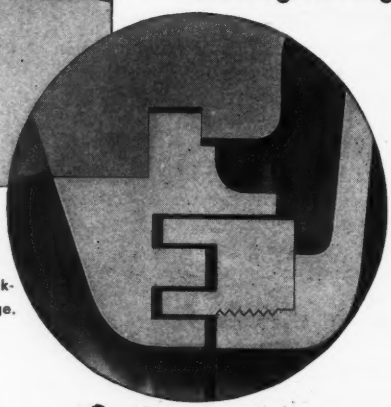
How HIGH EFFICIENCY *is sustained in* DE LAVAL MULTI-STAGE PUMPS

THE De Laval labyrinth wearing rings reduce leakage to one-third of that which occurs with flat rings having the same clearance. Because of the reduced leakage velocity, labyrinth rings have longer life.

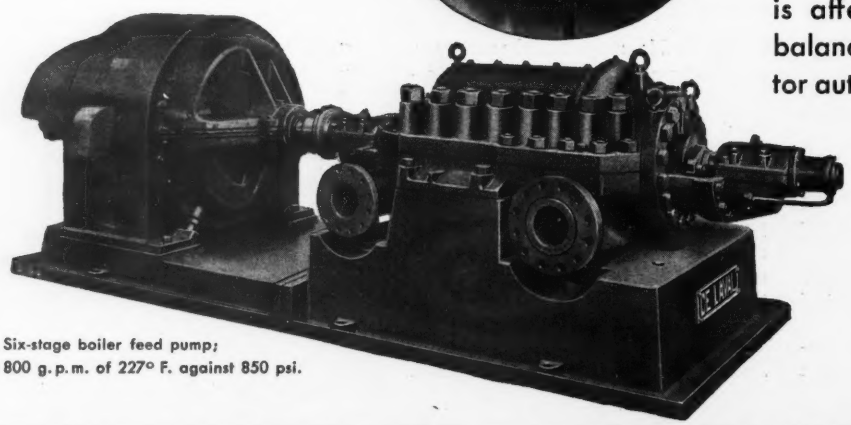
The De Laval multistage pump does not depend upon a thrust bearing to maintain axial position of rotor, but remains in perfect hydraulic balance under all operating conditions. Neither balance nor leak-off is affected by wear of the balancing disks, since the rotor automatically maintains the correct clearance.

All parts in a De Laval pump that are subject to wear are interchangeable and renewable.

Ask for Catalog P-3218



Labyrinth wearing rings, which minimize leakage from d scharge to suction in each stage.



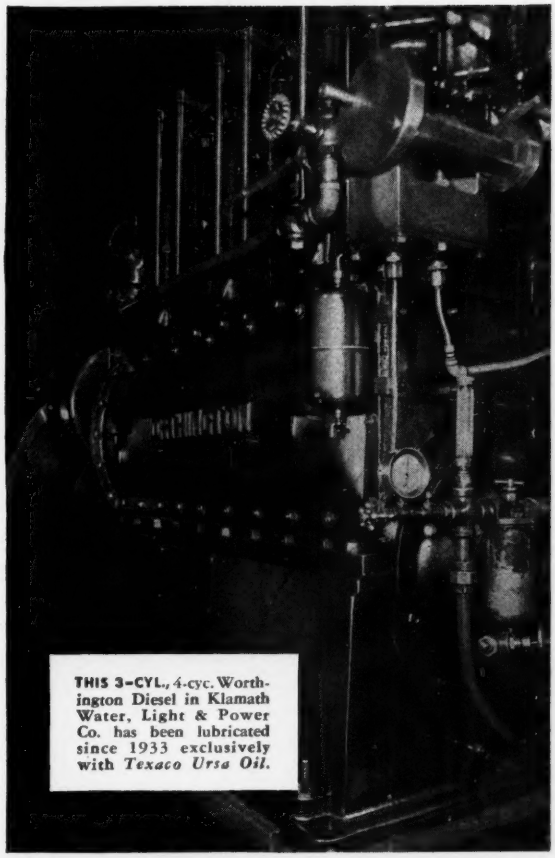
Six-stage boiler feed pump;
800 g.p.m. of 227° F. against 850 psi.

DE LAVAL *Steam Turbine Co.*
TRENTON, N.J.

MANUFACTURERS OF TURBINES / STEAM, HYDRAULIC; PUMPS CENTRIFUGAL PROPELLER ROTARY DISPLACEMENT, MOTOR-MOUNTED, MIXED-FLOW, CLOGLESS, SELF-PRIMING; CENTRIFUGAL BLOWERS and COMPRESSORS; GEARS, WORM, HELICAL; and FLEXIBLE COUPLINGS

HYDRAULIC INSTITUTE U.S.A. MEMBER

46,000 Hours, Original Rings!



THIS 3-CYL., 4-cyc. Worthington Diesel in Klamath Water, Light & Power Co. has been lubricated since 1933 exclusively with *Texaco Ursa Oil.*

AVERAGING 18 hours a day for 7 years in the Klamath (Calif.) Water, Light & Power Company plant, this 50-kw. Worthington Diesel's performance data show—

1. *Never a stuck ring.*
2. *Original rings still in use.*
3. *Liner wear only .008" at top; not measurable at bottom.*

Throughout these 7 years the only lubricant used was *Texaco Ursa Oil.*

Texaco Algol and *Ursa Oils* resist the formation of gum, sludge and hard carbon. They provide a tough, wear-defying lubricating film that withstands high temperatures and pressures.

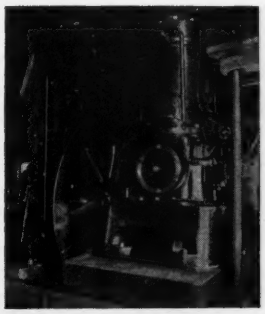
Your Diesel engines, whether large or small, will operate better on Texaco. In fact . . . *more stationary Diesel horsepower in the United States is lubricated with Texaco than with any other brand.*

Trained lubrication engineers will gladly cooperate in making savings with *Texaco Algol* or *Ursa Oils* in your Diesels. Phone the nearest of more than 2300 Texaco warehousing points in the 48 States, or write:

The Texas Company, 135 East 42nd Street, New York, N. Y.

WEAR in the Worthington cylinders was only .008 in. at top after 7 years of 18-hour a-day operation on *Texaco Ursa Oil.*

NEVER A FAILURE . . . which could be attributed to the oil . . . not even a shut-down, reports Blue Line Hosiery Mills, Inc., Denver, Pa., referring to their 2-cyl. F M Diesel. They use Texaco Diesel lubricants exclusively.



THIS 1-CYL., 2-cycle F-M unit is also giving an excellent account of itself in the Klamath plant . . . thanks to 7 years on *Texaco Ursa.*

TEXACO DEALERS INVITE YOU TO ENJOY

FRED ALLEN in a full-hour program every Wednesday night. CBS, 9:00 E.S.T., 8:00 C.S.T., 10:00 M.S.T., 9:00 P.S.T.

METROPOLITAN OPERA every Saturday afternoon, NBC. See local newspaper for time and station.

TEXACO

TEXACO Algol and Ursa Oils

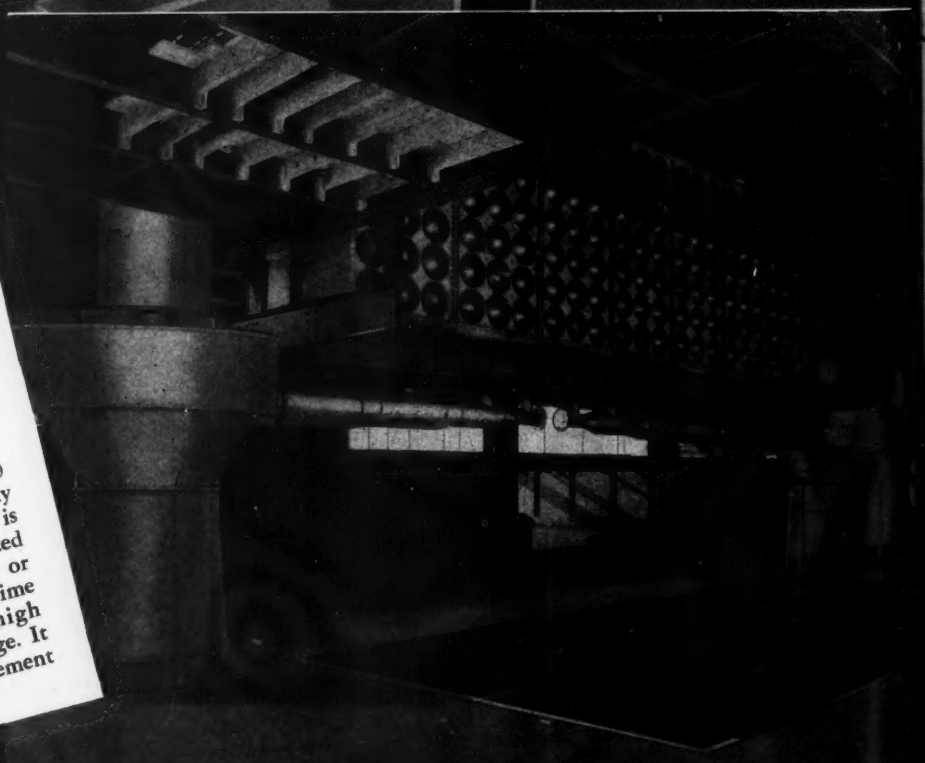
AMERICAN

INDUCED DRAFT FANS

American Blower Induced Draft Fans (shown at right) are built in a complete range of sizes, types and capacities. Both the Forward Curved Blade type, occupying minimum space, and Radial Blade types are dependably operating in many of the nation's newest and finest power plants.

DUST PRECIPI-TATORS

The American Blower Type "ST" Dust Precipitator (shown at right) is of the centrifugal type, primarily designed for power plant use. It is equally adaptable for both pulverized and stoker fired boilers in new or present plants. This practical, time proved unit operates with high efficiency over a wide load range. It is possible to vary the arrangement to meet specific problems.

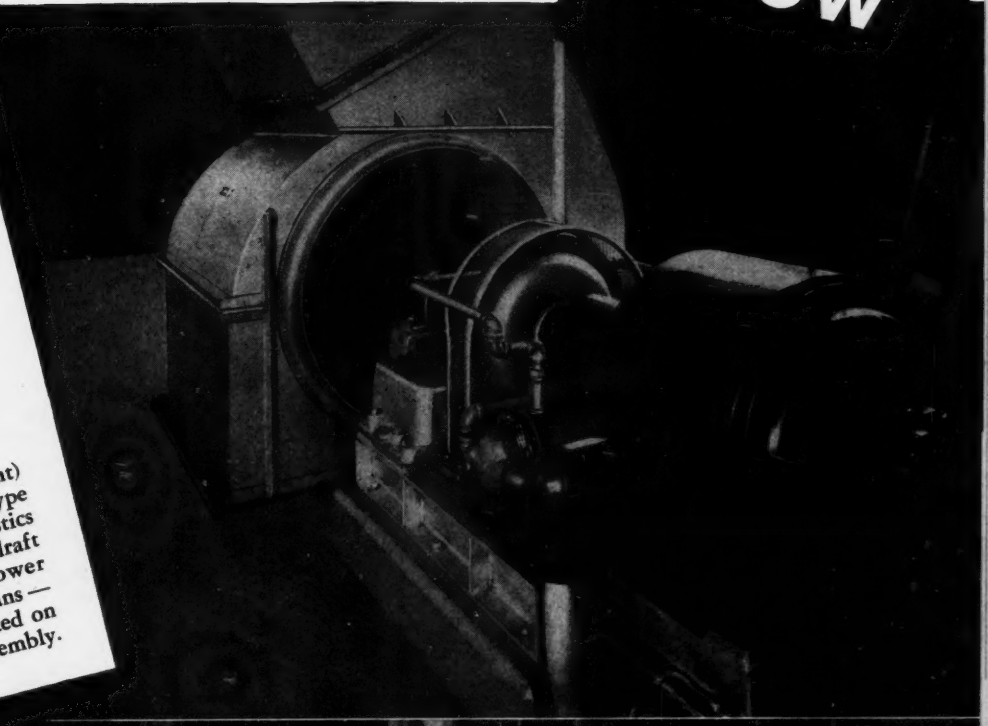


BLOWER

See our Exhibit at the POWER SHOW

FORCED DRAFT FANS

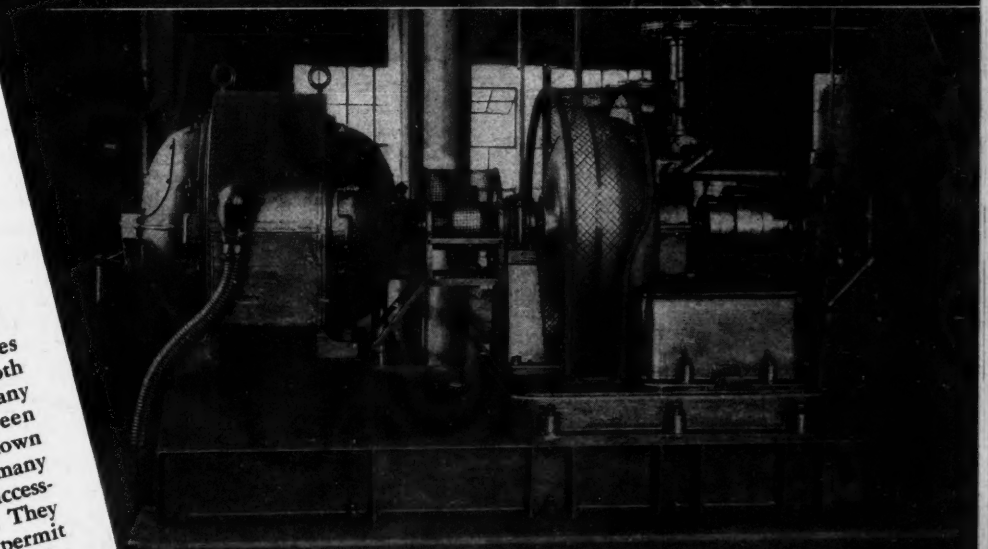
"AHS" Forced Draft Fans (right) are of the backward blade type with performance characteristics particularly suited to forced draft applications. American Blower also builds Duo-Draft Fans—Forced and Induced—mounted on one shaft and bearing assembly.



FLUID DRIVES

(Hydraulic Couplings)

American Blower Fluid Drives (Hydraulic Couplings), for smooth transmission of torque without any mechanical connection between driving and driven members (shown at right), have proved their many advantages in hundreds of successful power plant applications. They provide "stepless control," permit use of simple, constant speed driving motors, eliminate starting shocks, save power, reduce erosion on Induced Draft Fans, are readily adaptable to automatic control and improve the over-all plant efficiency.

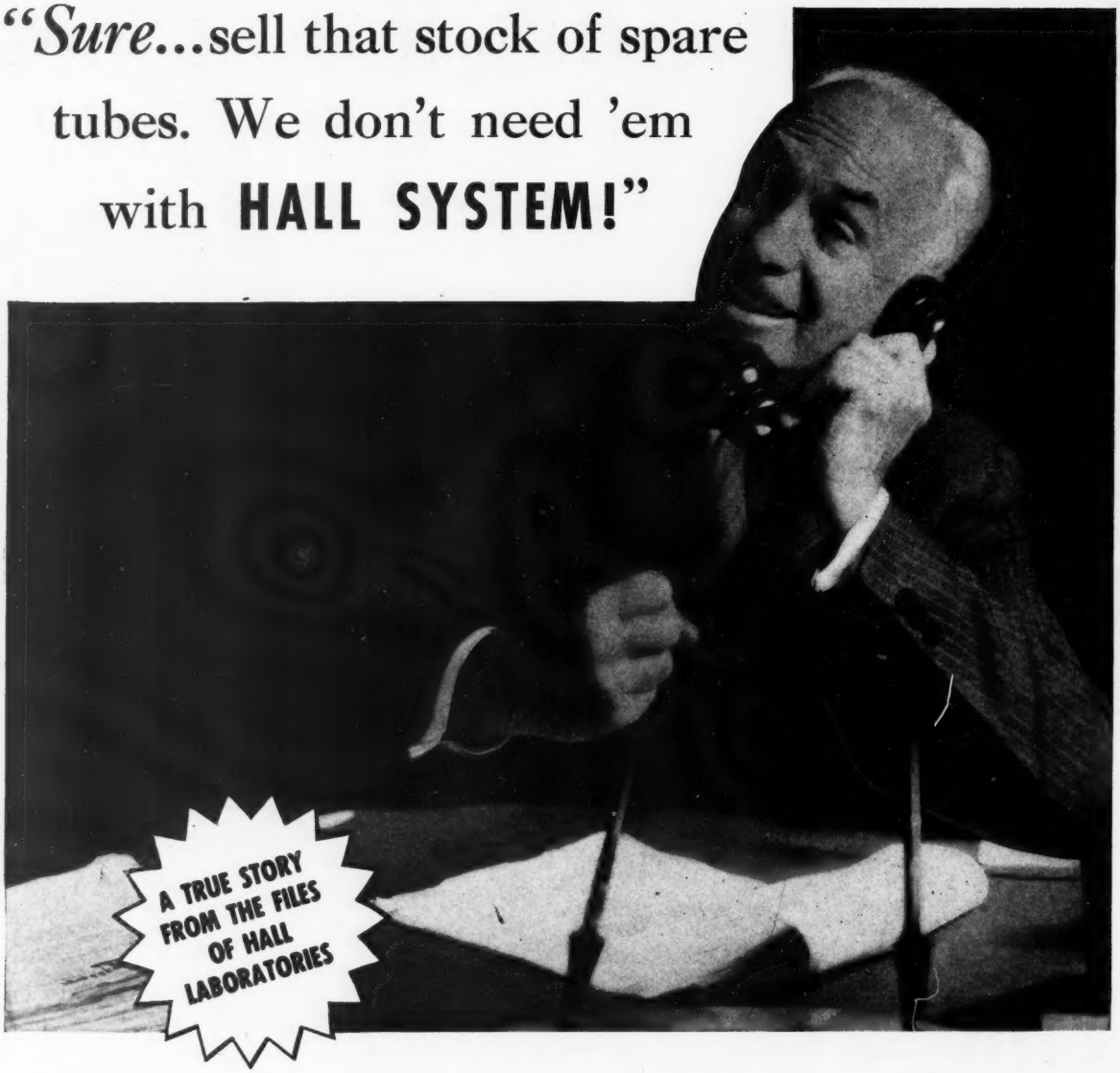


AMERICAN BLOWER CORPORATION

Division of American Radiator and Standard Sanitary Corporation

6000 Russell St., Detroit, Mich. • Canadian Sirocco Co., Ltd., Windsor, Ont.

"*Sure*...sell that stock of spare tubes. We don't need 'em with **HALL SYSTEM!**"



No longer need any power plant suffer unscheduled outages because of scale and corrosion

ONE spring several years ago a new 400-psi boiler was installed by an electric products manufacturer. Make-up was 100% hard water, through a lime-soda softener. The superintendent played along with a "cure-all" boiler compound all summer and fall. *But not one week of operation passed without tube failures taking the boiler off the line!* In December, 16 more tubes burned out in the bottom row. This was the final straw, and we were called in.

Exact control of the boiler water, with continuous maintenance of phosphate therein, was established by engineers of Hall Laboratories and taught to the operators, along with the most effective system for operating the softener. The boiler responded immediately. Continuous and economical operation followed and has continued throughout the intervening years.

After two or three years of Hall Service, with not a single tube failure occurring, the superintendent sold the huge stock of spare tubes he had purchased during his early trouble.

Hall Service stops outages before they occur. With correct water conditioning, boilers stay clean and do not develop trouble from scale or corrosion even when operated at capacity continuously.

Write today, now, for a copy of our new booklet "17 Case Histories from the Files of Hall Laboratories." It shows how many widely differing boiler problems have been solved by the application of Hall System principles.

HALL LABORATORIES, INC. · 300 ROSS STREET · PITTSBURGH, PA.

HALL SYSTEM *of Boiler Water Conditioning*

HOW FUEL DOLLARS ARE SPENT

Shows Up Here

Boiler Room Instrument Panel Board installed at The Glidden Company, Chicago, Ill., shows Brown Electric CO_2 Meters and Stack Temperature Recorders mounted on second and fourth panels. Other Brown Instruments include Steam Flow Meters, Thermometers and Pressure Gauges.

Various industries—various conditions—all sorts of plants from public utilities to schools and colleges secure efficient combustion by means of Brown CO_2 Meters.

This means fuel savings ranging from 10% to 15% of the fuel dollar are being effected. For example: A nationally-known chemical company in Baltimore, using Brown CO_2 Meters as a firing guide, saved $2,000 a month on fuel costs.

Similar savings can be made in your plant—Brown Electric CO_2 Meters provide operators and engineers with an adequate means of continuously and conveniently knowing per cent CO_2 content and temperature of furnace flue gases, for per cent CO_2 is the recognized and fundamental yardstick of combustion efficiency.

Engineers who have used the Brown CO_2 Meter as a firing guide for years, express 100% satisfaction.

The Brown Electric CO_2 Meter eliminates all calculations. All you do is read it—just as you read your flow meter. It's accurate because the relation between the thermal conductivity of flue gas and CO_2 content is fixed—definite—scientifically certain.

And it's Fast. That is another thing you want in a CO_2 Meter—Speed. The comparison cell now used with the Brown Electric CO_2 Meter has reduced lag to a remarkably low factor.

Ask for more facts about the Brown CO_2 Meter. It's easy to install. Write for Catalog No. 3006. THE BROWN INSTRUMENT COMPANY, a division of Minneapolis-Honeywell Regulator Co., 4491 Wayne Avenue, Philadelphia, Pa. Offices in all principal cities. Toronto, Canada: 117 Peter Street—Amsterdam-C, Holland: Wijdesteeg 4—England: Wadsworth Road, Perivale, Middlesex—Stockholm, 16, Sweden: Nybrokajen 7.

Features of Brown CO_2 Meter

1. Practically no time lag.

2. No long piping required. The analysis unit is located close to the sampling tube and connected to the recorder electrically, thus permitting recorder location at a convenient place.

3. Continuous sampling and continuous recording.

4. Can be combined with thermo-electric pyrometer — the most flexible method of measuring flue gas temperature.

5. Is sensitive to hydrogen—a feature of much use to a wide-awake fireman.

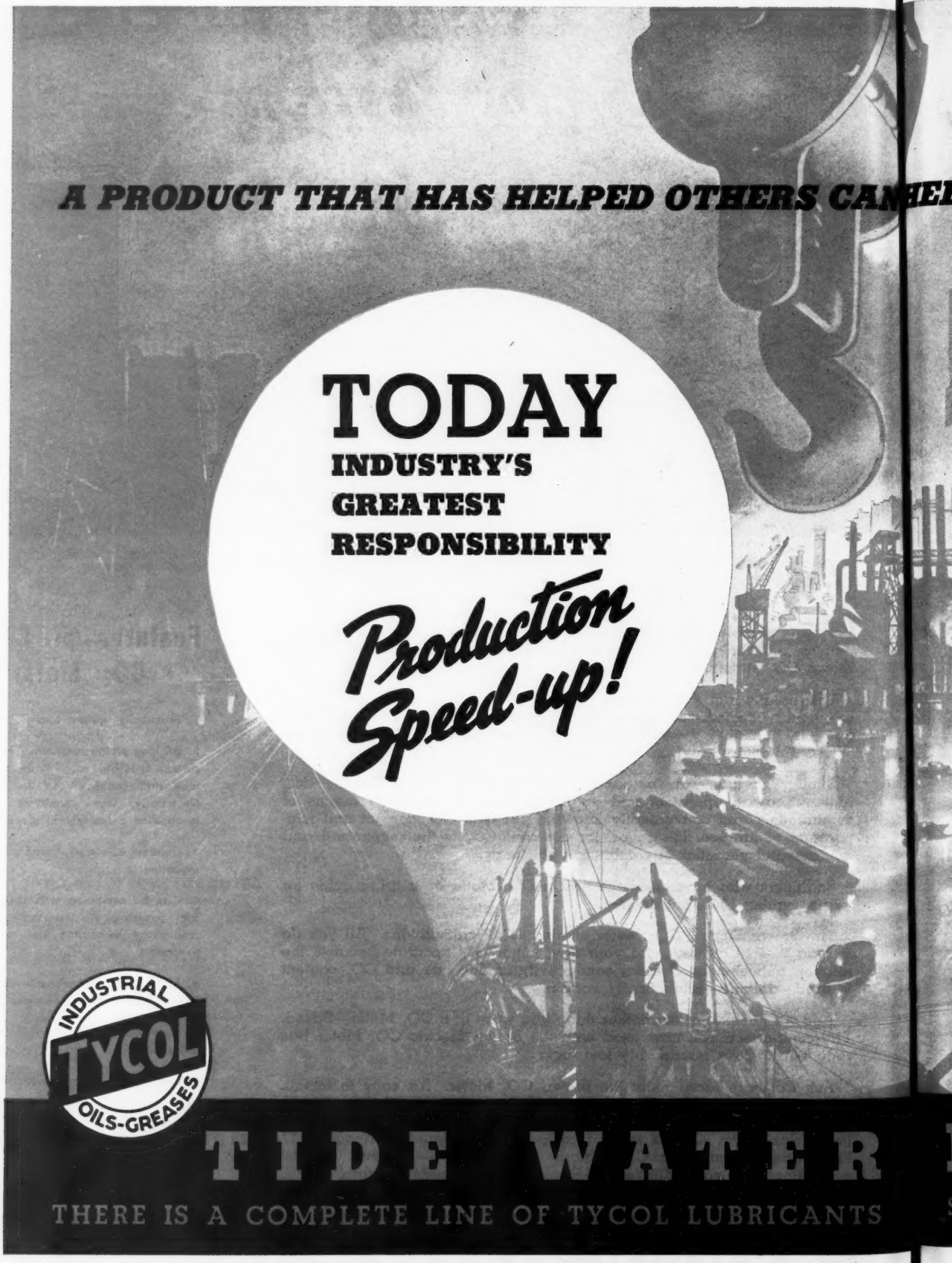
6. Operates entirely on A.C. No batteries, etc.

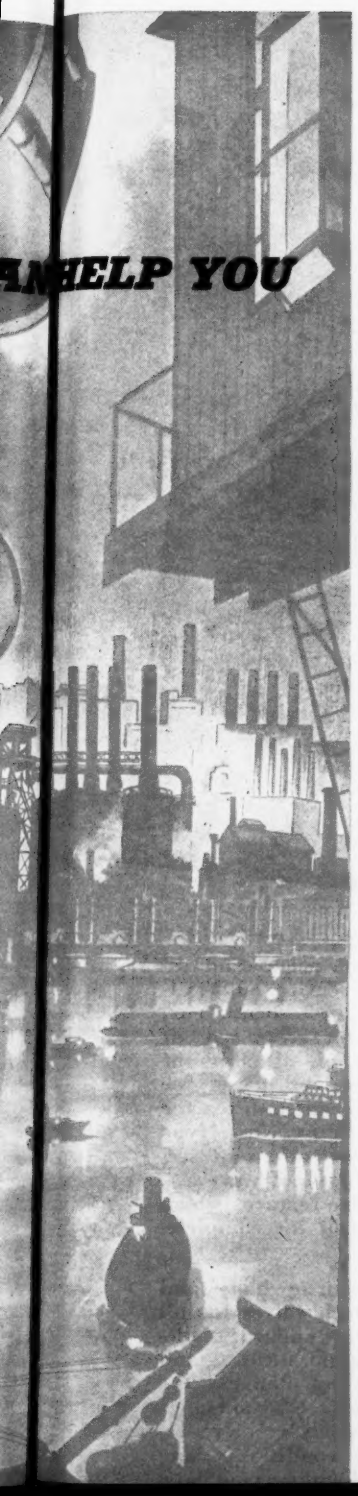
7. Stable and unchanging calibration.

The Brown Electric CO_2 Meter will be on display at The National Exposition of Power & Mechanical Engineering, Booth 45, Grand Central Palace, New York, Dec. 2nd-7th.

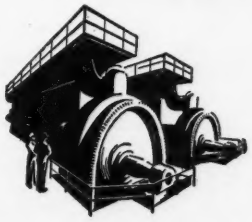
BROWN ELECTRIC CO_2 METERS

To Measure and Control is to Economize


A PRODUCT THAT HAS HELPED OTHERS CAN
TODAY
INDUSTRY'S
GREATEST
RESPONSIBILITY
Production
Speed-up!
INDUSTRIAL
TYCOL
OILS-GREASES
TIDE WATER
THERE IS A COMPLETE LINE OF TYCOL LUBRICANTS



FOR THESE TWO DIESELS



. . . . the waste of frequent changes, carbon and sludge was proved needless by . . .

TYCOL DIESEL OIL

"The power for our plant is supplied by two 45 h.p. Diesel engines," this engineer explained. "These are lubricated with Tycol Diesel Oil, an oil we have been using for almost 3 years. We feel that it is doing an outstanding job."

"The room temperature is usually around 120°. This, plus the fact that the Diesels are running with an almost capacity load for 14 hours a day, demands an exceptionally good oil. We have found that ordinary oil under such circumstances breaks down and runs like water. We would get overheating with damage to cylinders and bearings."

"With Tycol Oil we now find on opening the engine that the rings are not stuck with hardened carbon and are not difficult to replace. We also find that the crankcase is almost entirely free from sludge in spite of the tough lubricating job."

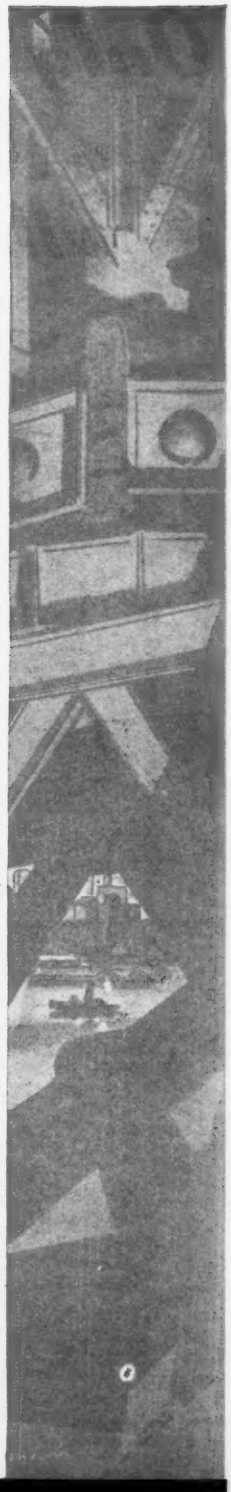
Regardless of operating conditions, on Diesels large or small, Tycol Diesel Oil is the answer. It assures maximum performance per gallon of lubricant. Our representatives will be glad to assist you in selecting the proper Tycol Oil "engineered to fit your needs." Write for full details.

TIDE WATER ASSOCIATED OIL COMPANY

EASTERN DIVISION

17 Battery Place • New York, N. Y.

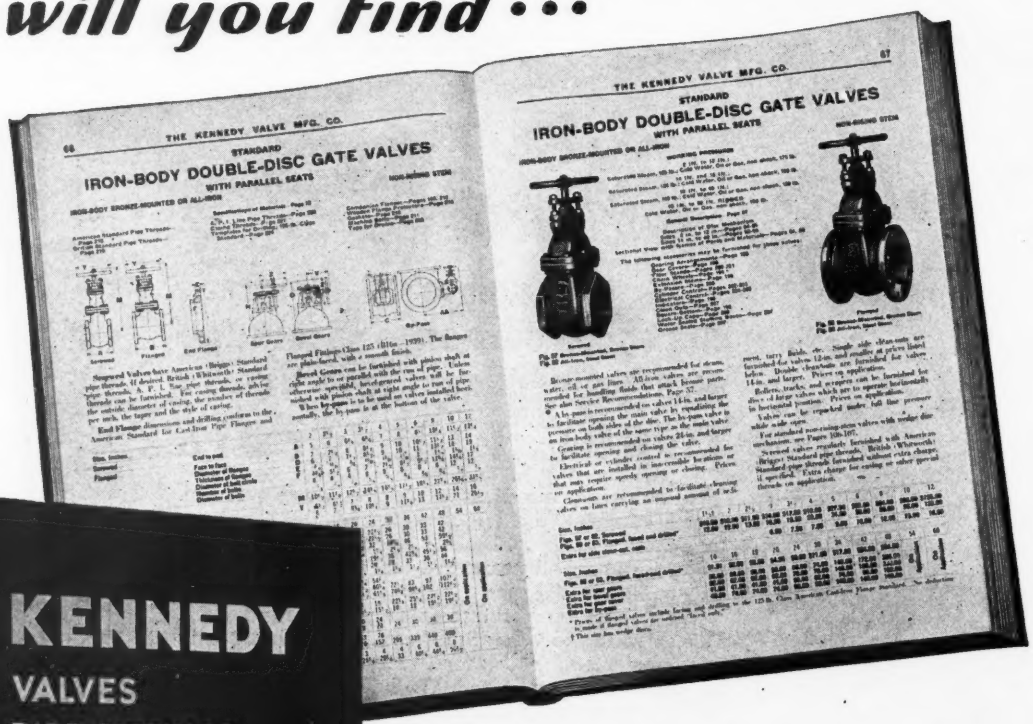
Regional Offices: Boston, Philadelphia, Pittsburgh, Charlotte, N. C.

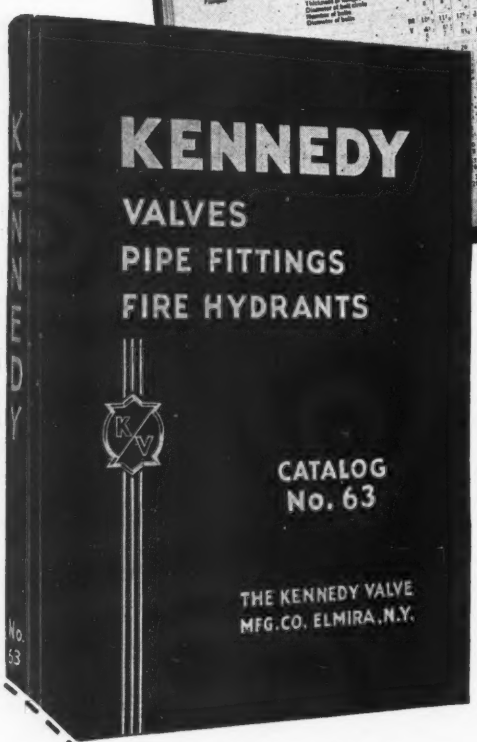


DIESEL OIL

SCIENTIFICALLY ENGINEERED FOR EVERY INDUSTRIAL USE

Only in the NEW KENNEDY CATALOG *will you find . . .*





• • • complete information on prices and dimensions, recommendations for service, and reference to design details, special accessories, etc., *all on the same or facing pages for every type of valve* . . . uniform arrangement of all tables of pipe fittings, together with complete prices for each kind of finish . . . five different indexes for greatest ease in locating products by class, type and figure number . . . large illustrations of sectional and exterior views of every type of valve . . . and a multitude of other distinctive features which place this catalog in a class by itself for completeness and convenience.

The new Kennedy catalog lists iron body and bronze gate, globe, angle and check valves for all standard services and pressures, standard malleable iron and bronze screwed pipe fittings, and cast iron flanged pipe fittings and flanges; the Kennedy Safetop and Standard Fire Hydrants; various valve specialties; a wide variety of valve accessories for special operating conditions; and includes a large section of helpful engineering data.

Send the coupon for your copy

The Kennedy Valve Mfg. Co., Elmira, N. Y.

Please send copy of your new Catalog 63.

Name.....

Position.....

Company.....

Address.....

The Kennedy Valve Mfg. Co., Elmira, N. Y.

KENNEDY

Valves and Pipe Fittings

VERSATOL INSULATED Cable

REG. U.S. PAT. OFF.

Has influenced the trend away from lead sheath toward the lower-priced nonmetallic cable

The unusually low water-absorption factor of Versatol—0.01 gram per sq in.—is the reason why this G-E cable seldom needs a lead sheath.

But it has other cost-saving features. The operating temperature is 75 C, which may allow a reduction in conductor size. The 504 hours in the oxygen bomb is said to approximate 50 years of natural aging, and that is evidence of long life and freedom from costly maintenance.

Thus, Versatol is economical.

These specifications, in brief, are the reasons why.

0.01 "The increase in weight . . . by the absorption of water . . . shall not be more than 0.01 gram per sq in."

75 C "The tensile strength . . . after 120 hours in the air oven at 121 C (250 F) . . . shall not be less than 1000 lb per sq in." This is comparable with a maximum allowable operating temperature of 75 C.

504 "The tensile strength . . . after 504 hours in the oxygen bomb . . . shall not be less than 75 per cent of the original value."

For more detailed specifications on Versatol insulated cable, see Bulletin GEA-2110. Or consult a G-E cable specialist. Address the nearest sales office or General Electric Company, Schenectady, N. Y.

Tellurium Parkway
(Shielded)

A POPULAR NONMETALLIC TYPE

This is one of the many types of Versatol insulated cable. It is a parkway type for direct burial and for other uses without ducts. The combination of Versatol (*for dielectric strength*) and tellurium-rubber sheath (*for mechanical protection*) forms a simple, nonmetallic cable that keeps down costs. It is low in price—lower than that of any metallic-armored cable. It is inexpensive to install—requires no stripping of lead or armor, no wiping of joints. It is light, flexible, and easy to handle. The tellurium-rubber sheath is tough and also resists moisture, soil acids, and alkalies. The cable will last.

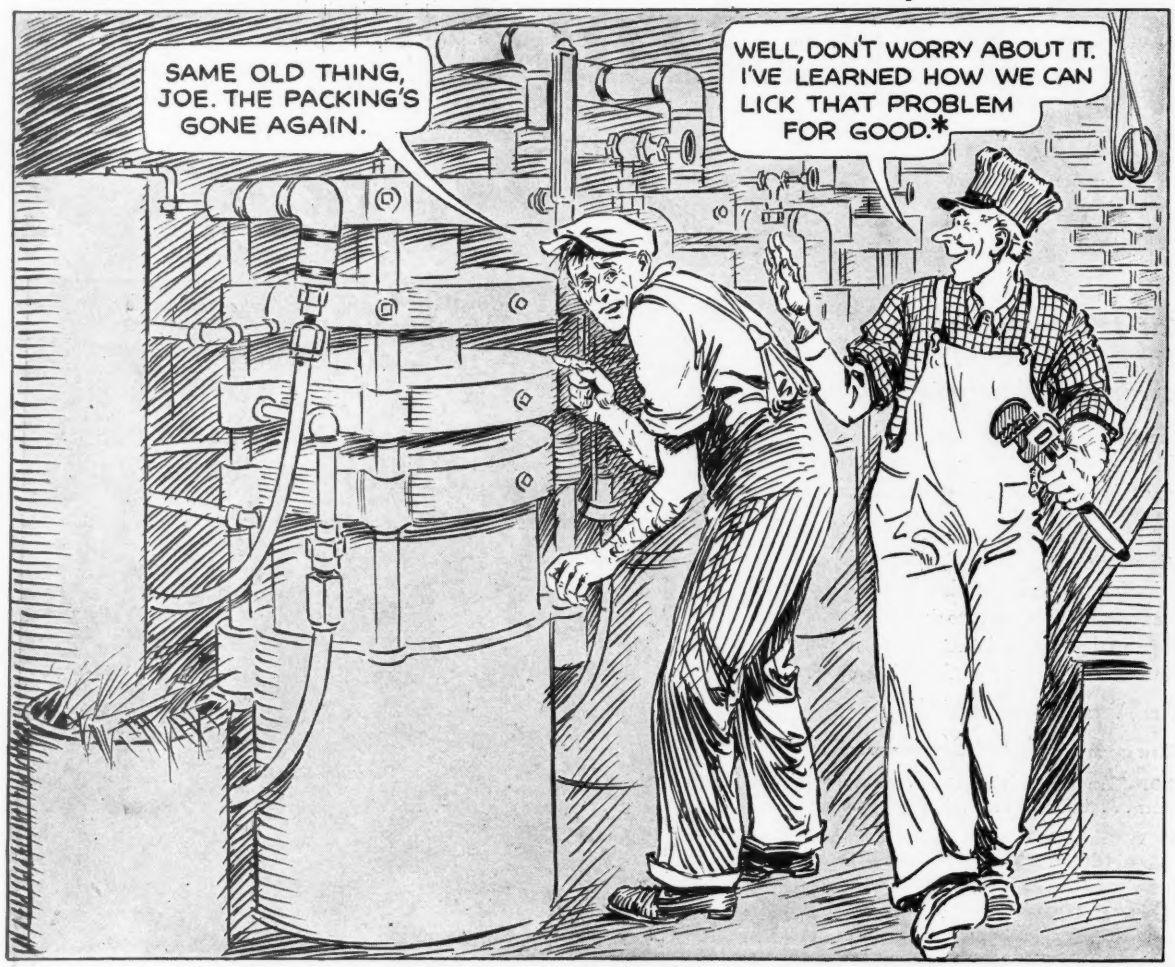
You profit most when the insulated cable you select for each job is *always* the right one. To this end, make full use of G-E service and get the most for your cable dollar. Look to the *right* type for long-term economy.

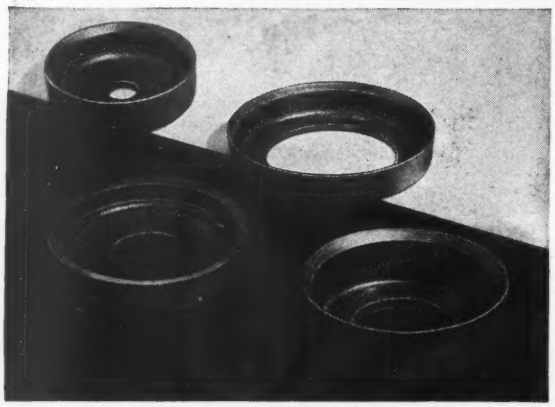
GENERAL ELECTRIC

500-7

KEEPING 'EM ROLLING

By WESTCOTT





J-M MOULDED PACKING CUPS for steam brake cylinders, hydraulic presses, air hoists and slow-moving pistons with a relatively short travel. The composition is varied to meet service conditions.

*WHAT JOE LEARNED . . . *J-M Packing Cups last longer . . . provide a tighter seal*

YOU can't figure packing costs on *materials* alone. For every replacement means a shutdown . . . and every shutdown means extra labor, idle equipment. To cut these expenses, engineers are standardizing on J-M Moulded Packing Cups for slow-moving pistons and rams. These durable packings come in a wide variety of types and shapes . . . each for a specific service. All are moulded to the exact size needed . . . assure free action. Like every packing in the complete J-M line, they provide long, dependable life . . . boost efficiency, lower costs. For details on J-M Packings and Gaskets, write for Catalog PK-3A. Johns-Manville, 22 E. 40th St., New York, N. Y.

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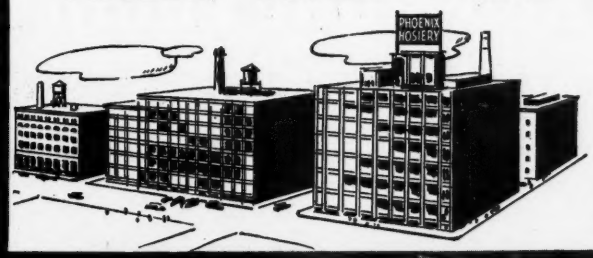
PHOENIX HOSIERY TURNS AN OLD POWER PLANT INTO A "Gold Mine"



HAGAN CONTROL
part of modernization plan which
SAVED $41,867 A YEAR
DOUBLED CAPACITY OF UNITS
ELIMINATED 1 BOILER PLANT

PART OF Hagan Combustion Control System, Furnace Draft Controllers and Receiving Regulator, which helped save over $8,600 in the plant of Phoenix Hosiery Company. As the cost of fuel is the largest item in the total cost of power plant operation, efficient combustion control is of vital importance. Hagan Control is noted for its efficiency, speed, sensitivity, power and stability.

DOES power plant modernization pay? Phoenix Hosiery Company discovered it does. Through a long-range modernization program, they changed an old, wasteful power system into an efficient plant that quickly paid for the improvements.

The following plan was adopted: (1) Remove scale from boilers. (2) Replace all piping in plant No. 1 with new standard piping. (3) Install automatic combustion control with the necessary instruments. (4) Rebuild furnaces and install water-cooled arches in plant No. 1. (5) Shut down plant No. 2 with the exception of one engine and a motor-generator set.

The Hagan control and instruments included in the modernization program alone effected a coal saving of 1727 tons per year, or $8635—21% of the total savings achieved. It took only 15 months to pay for this equipment which, according to plant engineers, has been earning handsome dividends ever since.

Let us help you make YOUR plant pay similar dividends. Our 25-year-old files are crammed with instances in which Hagan control paid for itself shortly after installation and then went on to effect substantial fuel savings—REAL operating economies.

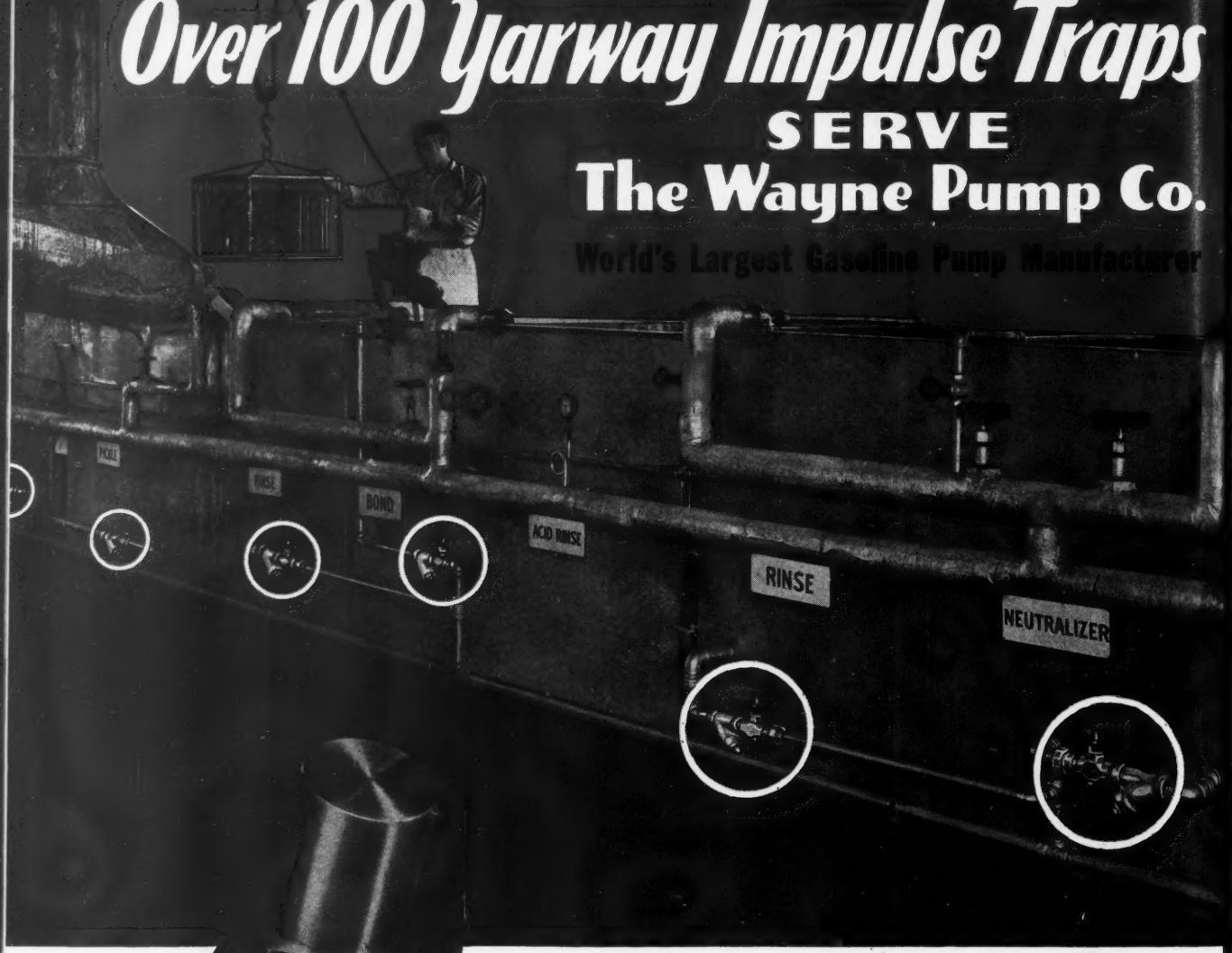
We'll gladly send an experienced Hagan engineer to study conditions in your plant. Just call or write.

HAGAN CORPORATION 300 ROSS ST. PITTSBURGH, PA.

HAGAN *Automatic* COMBUSTION CONTROL
The pioneer . . . and still the leader

Over 100 Yarway Impulse Traps SERVE The Wayne Pump Co.

World's Largest Gasoline Pump Manufacturer



See our Exhibit—Booth No. 66, Power Show, Grand Central Palace, New York City, December 2 to 7, 1940

THE Wayne Pump Company, now entering the 50th year of service to the oil marketing industry, are the originators of the computing type gasoline pump.

They also are enthusiastic rooters for Yarway Impulse Traps—use them throughout their plant.

Why? Because they like the YARWAY'S efficient service in getting equipment hotter, sooner; their compactness; their few working parts; and because they are adaptable to the various pressures encountered in different manufacturing operations without change of valve or seat.

Shown above, are six of twelve Yarway traps and strainers installed on metal pickling and acid cleaning vats in preparing metal for porcelain. These traps have long been in this continuous, hard service without adjustment, cleaning or other attention.

Yarway Impulse Traps are the dependable solution to many steam trap troubles—are a big help in the profitable operation of all kinds of steam equipment. And when you consider that their purchase price is usually no more than the cost of repairing an old type trap—why not get Yarway performance for your money?

See your nearby mill supply distributor or write for catalog T-1735.

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YARWAY IMPULSE STEAM TRAP